MACHINERY.

Vol. 8. March, 1902. No. 7.

NEW SHOPS OF THE GRANT TOOL CO.

We have already had occasion to refer to the new works of the Grant Tool Co., Franklin, Pa., the formal opening of which occurred last October. These shops were very carefully planned, are of the most modern construction, and are intended to embody all that is latest and best in design and arrangement.

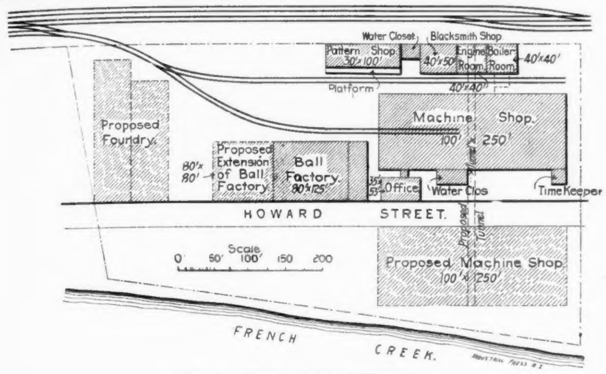


Fig. 1. Plan of New Works.

The Grant Tool Co. is a consolidation of the Grant Machine Tool Co. and the Grant Ball Co., both of Cleveland, O., and the interests and business of these two firms have been absorbed by the new firm and such part of their equipment as was needed was moved from Cleveland to Franklin for use in the new plant. The President of the Grant Tool Co. is Gen. Charles Miller, of Franklin; John J. Grant is Vice-President and General Manager; O. D. Bleakley, Treasurer, and A. R. Davis, Secretary. The products of the Grant Tool Co. include lathes, boring mills, drilling and milling machinery, and special machinery. Considerable attention is being given to tools for railroad shops and the manufacture of balls of steel and other metals is an important part of the business.

A plan of the new works, with the location of the proposed additions, to meet the future growth of the business, is shown in the diagram in Fig. 1. In Fig. 2 is a general view of the shops and office building. The plant is located near the business section of Franklin, occupying two blocks between a river known as French Creek and the tracks of the Erie Railroad. The main machine shop occupies a space 100 by 250 feet and consists of a central section about 50 feet wide in which there is a traveling crane, and two wings each 25 feet wide.

The office building is 35 by 53 feet, two stories high, and is located in front of the machine shop. It is of buff colored brick with simple but substantial interior finish of oak. On the first floor are the business and executive offices and on the second the drafting room. Back of the machine shop are the engine and boiler house, the pattern shop, and the blacksmith shop. Power is transmitted to the main shop by a rope transmission system located in a tunnel connecting the engine room with the shop. The tunnel is indicated in Fig. 1 and it is shown how it can be extended to the proposed addition to the machine shop when required. At the left of the machine shop and office is the ball factory and ample provision has been made for enlarging this department to double its present capacity. Still further to the left is land upon which a foundry will eventually be built.

The buildings were designed by the Osborn Engineering Co., of Cleveland, O. The main machine shop is of glass and steel construction, the side walls being entirely of these materials with the exception of brickwork at the base, which extends to a height of three and a half feet. In Fig. 3 is a half sectional view of the main shop and details of the upper and lower windows are also shown. The lower sashes and those under the eaves of the main roof are arranged to pivot so that they may be opened for ventilation. The glass is the ordi-

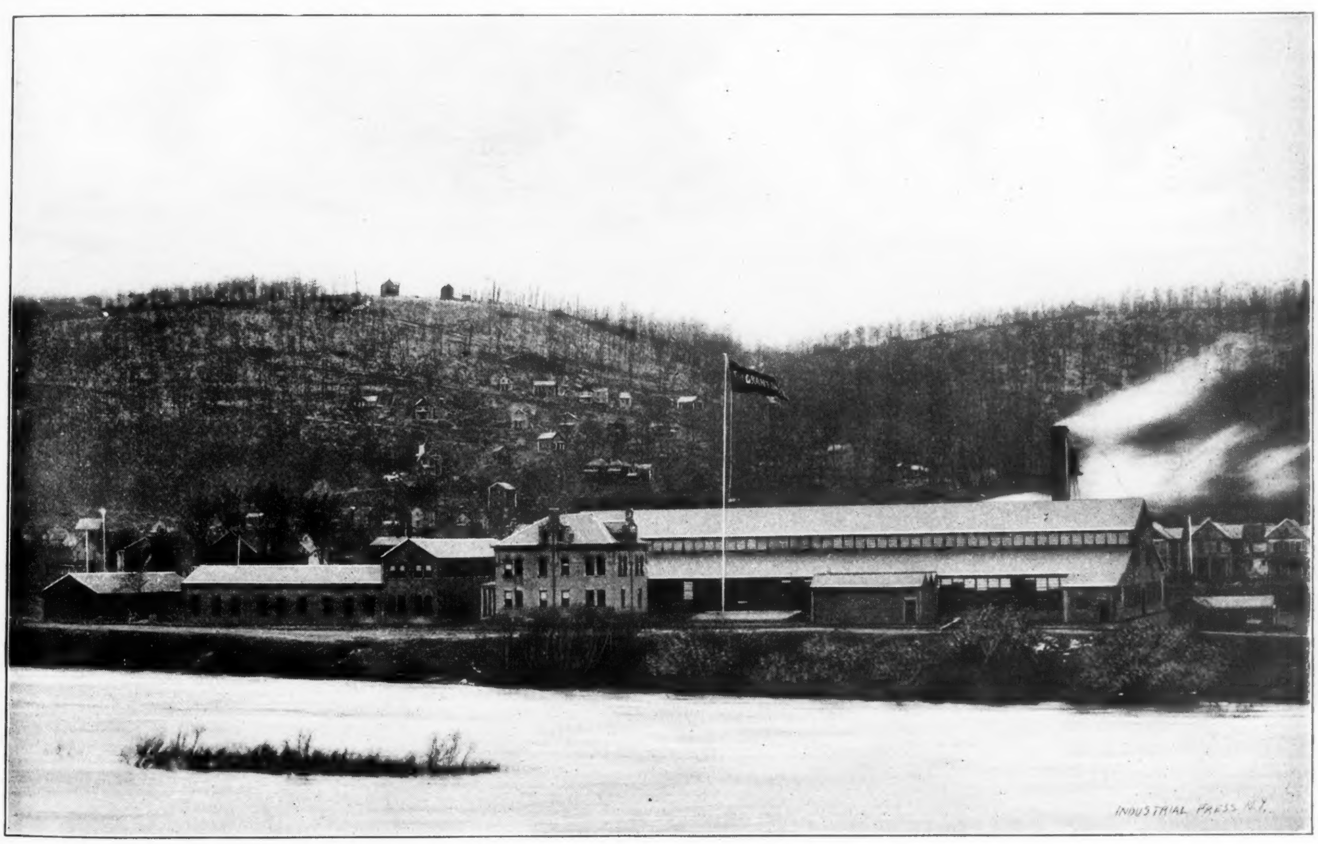


Fig. 2. General View of the Works of the Grant Tool Co., Franklin, Pa.

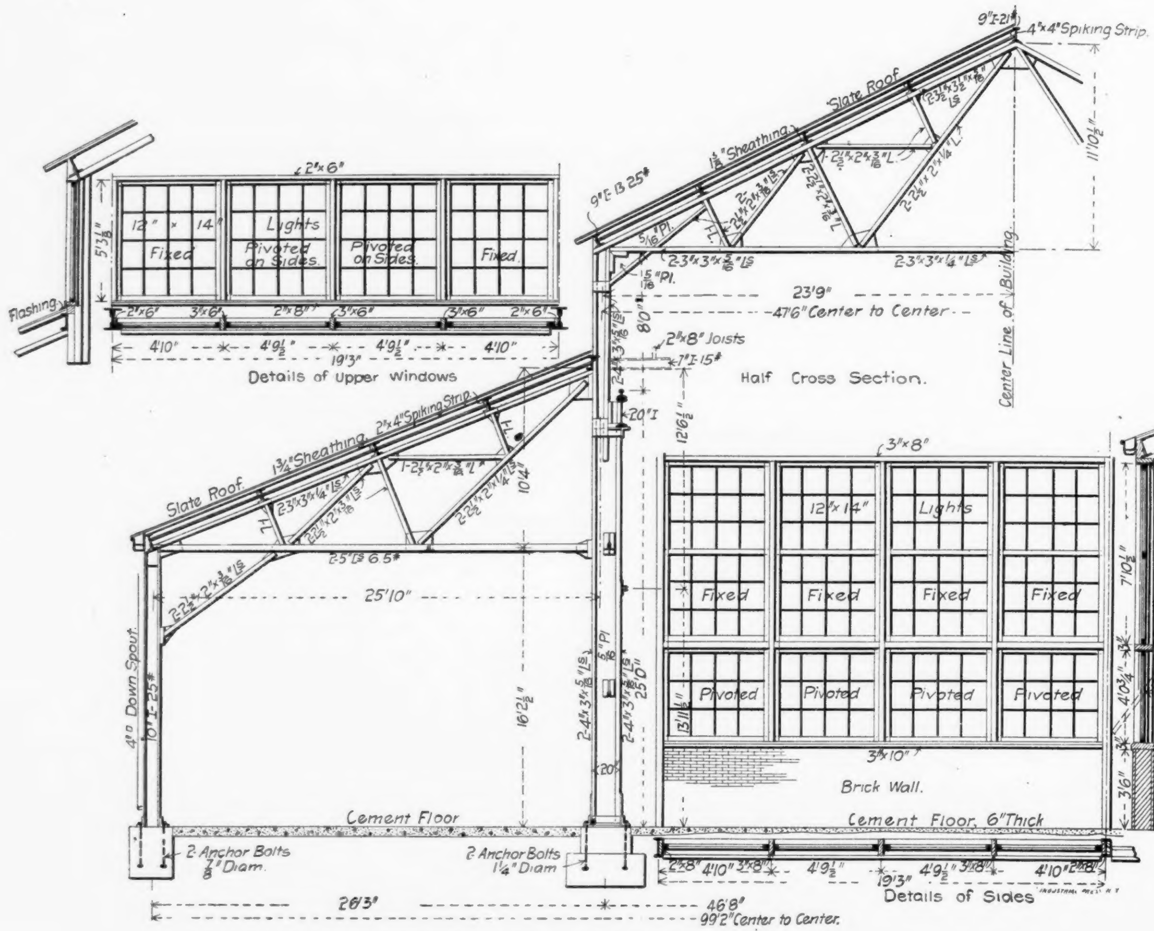


Fig. 3. Half Sectional View of Main Shop with Details of Windows.

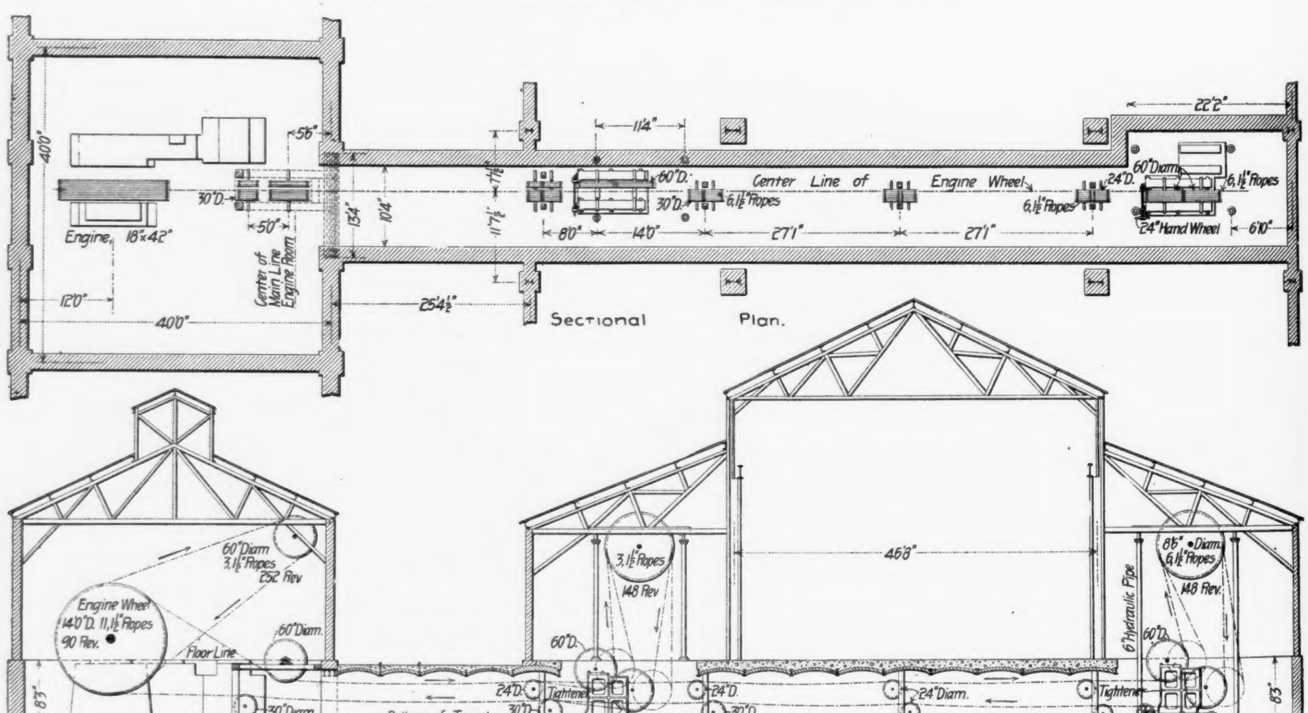


Fig. 4. Plan and Elevation of Tunnel and Power Transmission System.

nary transparent window glass and roller shades are used to keep out the glare of the sunlight. The framework of the building is of standard rolled steel shapes, the dimension of the principal members being shown in Fig. 3. The floor of the shop is of cement, six inches thick.

There are two tool rooms in the shop occupying central positions in each side wing. One of the tool rooms is used for tool making and repairing and the other for the storage and distribution of tools. A large annunciator is located in front of the latter tool room and push buttons on the shifter handles of the various machine tools in the shop give means of signalling when tools or supplies are wanted. Messenger boys are employed to answer calls and carry tools to the operators or machinists and to return them to the tool room. The shop offices are at one end of the shop and are supported on girders above the shop floor so as to give clear floor room for construction work. At the opposite end is a large door through which a spur track enters from the Erie Railroad. The door is supported from above by counterweighted cables passing over pulleys and is opened and closed by raising and lowering.

To facilitate the erection of heavy tools there is a floor pit 15 feet long by 10 feet wide and six feet deep, having I-beams at intervals across the top. By erecting a machine upon the I-beams over the pit access can be had to the under sides of the castings and many parts are easily fitted that might otherwise cause trouble. Another convenience for erecting and laying out work is a large laying-out or surface plate bedded

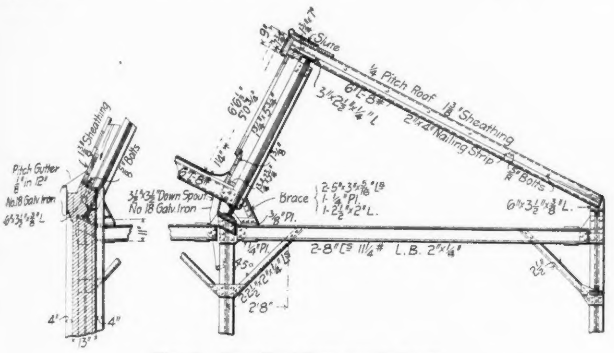


Fig. 5 Detail of Saw-tooth Roof.

in masonry and raised about three feet above the surface of the shop floor. It has a plane surface to work upon about 10 feet wide by 24 feet long, which is very solid and at a convenient height for the workman.

The power plant is a model one and the method of power distribution by means of the rope drive, through the connecting tunnel, is novel and efficient. In Fig. 8 is a view of the engine room. Power for the rope drive is supplied by a 250 H. P. Brown engine and a Thompson and Houston generator driven by a 75 H. P. Ball engine furnishes the current for lighting. The steam piping is carefully covered and a marble switchboard adds to the attractiveness of the room, which in its appointments and arrangement is a model in every respect.

No less attention has been paid to the arrangement of the boiler house. The boilers are set below the surface of the ground on the level with the floor of the basement under the engine room. There are two horizontal tubular boilers of 150 H. P. each, equipped with American stokers and Buffalo Forge Co.'s forced draft. Coal is dumped directly from the cars into a bin adjoining the boiler room and a Jeffrey Mfg. Co.'s conveyor takes ashes up to the cars on the ground level. The feed pumps, feed water heater, etc., are also in the basement. In the space under the engine room are the fan and coils for the Sturtevant shop heating system and a Franklin air compressor for supplying air for the shop tools.

The tunnel connecting the basement of the engine room with the machine shop is used as a conduit for conveying energy in several forms. It contains the air pipes from the compressor, electric wires, and pipe connections, besides the rope transmission system. The latter was installed by the Geo. V. Cresson Co., Philadelphia, and is shown diagrammatically in Fig. 4. There are eleven 1½-inch ropes in the drive, eight of which are for furnishing power to the two main lines of shafting in the machine shop and three for driving the line shaft for the pattern and blacksmith shops. The location of the rope tighteners and the connections with the three line shafts are clearly represented in the illustration. This tunnel system is convenient and accessible, for the distribution of power and for conducting wires, pipes, etc., to different distributing points.

In the ball factory are the automatic screw machines for roughing out the smaller sizes of balls from bar stock, the grinders for rough grinding and finishing the balls, oil heated hardening furnaces and the sorting and gaging apparatus. The building is of brick, the front portion being two stories high and containing the sorting, gaging and store rooms on the second floor, while the rear and main portion is one story and has a saw-tooth roof, giving a good overhead light. A detail sketch of the roof is shown in Fig. 5 and will need no explanation. The larger balls are forged in the blacksmith shop before grinding. The equipment here comprises a large drop hammer, two steam hammers and two Bradley power hammers. As there is very little smoke from down-draft forges and the room is

Fig. 6. View in Main Shop showing the Large Window Area. The Elevated Shop Offices are at the further end and one of the Tool Rooms can be seen at the Center of the Wing at the Left.

well ventilated it bears no resemblance to the ordinary blacksmith shop in points of light and cleanliness.

The Grant ball grinding machines and their principles of operation have already been described in these columns, as well as the methods for gaging and sorting. Fig. 7 is from a photograph of the latest type of gaging machine, which has much larger capacity than those formerly used and although the present article is intended to describe the shop buildings

Fig. 7. Ball Gaging Machine.

of the Grant Tool Co. rather than the methods of work, a brief reference to this machine may not be out of place. The balls are placed in the hopper at the top. At the bottom of the hopper is an annular ring which contains a series of holes slightly larger in diameter than the diameter of the balls. This ring is rotated by power and the balls drop into its holes and in turn pass through corresponding holes in a plate below the ring and roll down slots between inclined straight edges seen extending radially in the illustration. The straight edges are 1½ thousandths of an inch further apart at the bottom than at the top, and when a ball rolls down it reaches a point where the distance between the straight edges is equal to its own diameter and falls through and is guided to its proper compartment underneath by a chute or tube. This gages the balls but does not determine their degree of sphericity. They are tested for this by rolling on a flat glass tray, those which are perfectly round rolling in a straight line and the others taking a circular or zigzag path across the surface. The errant ones are removed by a pointed magnet.

The drafting room, of which a view is shown in Fig. 9, is light and comfortable and has a well equipped blueprint room. The drawing tables are all of uniform construction and are worthy of attention. Their general design will be evident from the one appearing in the foreground in Fig. 9. The two uprights are 1½-inch W. I. pipe. The legs are of 1-inch pipe and there are two cross pieces at the base and one at the top also of one-inch pipe. The drawing board pivots at the tops of two threaded rods passing through the two uprights and held in position by check nuts at the tops and bottoms of the uprights. The slotted segments for holding the board in position when tilted are of cast iron and they are clamped to the threaded rods above mentioned by cap screws, the uprights being slotted vertically to allow the screws to enter at whatever height the board may be raised. The construction is neat and firm and is almost entirely of pipe and pipe fittings.

Wash rooms are located conveniently for each of the shop buildings, but instead of the wash troughs so generally used in shops and factories, enameled iron basins are provided, one for each man, with hot and cold water faucets at each basin. The lavatory for the main shop is in what might be called a basement, although there is no building over it. It is at the side of the building, partially below ground and with a skylight over the whole, making a very light room. The water is heated in a tank by means of a steam pipe coil.

* * *

THE DRAFTSMAN.

A young man, after working a few years in a drafting room, says the *American Engineer*, asks us whether he was on the right track to success. He was told that he was and that some of the best railroad officers of the present time had spent a long time in this department. He went back to his table, determined to get out of the drafting room because of having shown his ability there. The next day brought the following letter, which we hope every draftsman will read:

"It seems to me to be a step in the right direction when one learns that there is no easy sailing, and makes up his mind to make an opportunity rather than wait for an opportunity to make him. I realize that it requires considerable determination and application to work ahead of oneself, preparing for something that may some time offer an opportunity, or striving to gain knowledge that may be of value some time. The beginning is undoubtedly half the undertaking in any work, and difficulties apparently enormous at first, taken each in turn as they present themselves, should become simpler and finally be overcome."

We hold that there is no better place in which to gain experience than the drafting room. We also hold that a man who is a good draftsman and who can organize and direct a drafting room properly has a combination of experience and qualities of the executive and the engineer which fit him for greater responsibilities. If this department is not appreciated, not only is a good opportunity lost by the management, but a number of promising, ambitious young men are discouraged and a great mistake is made. Drafting in railroad service is usually drudgery, but the men themselves may be to blame for this. They usually have it in their own hands to make its importance felt and to make the drafting room a good stage in progress from which they may graduate because of showing that they have a grasp on affairs with which they deal.

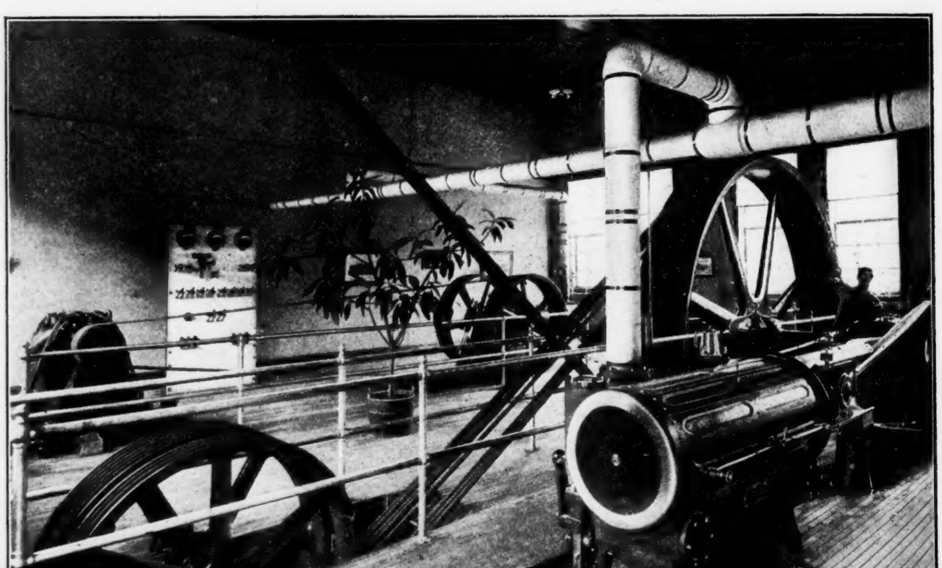
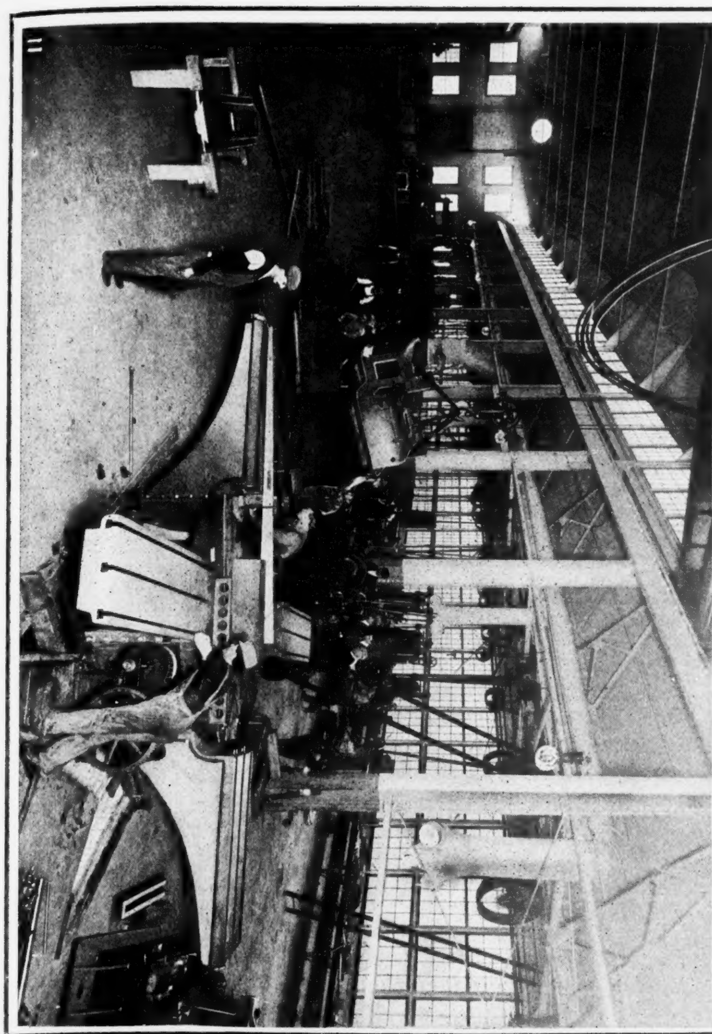


Fig. 8. The Model Engine Room.



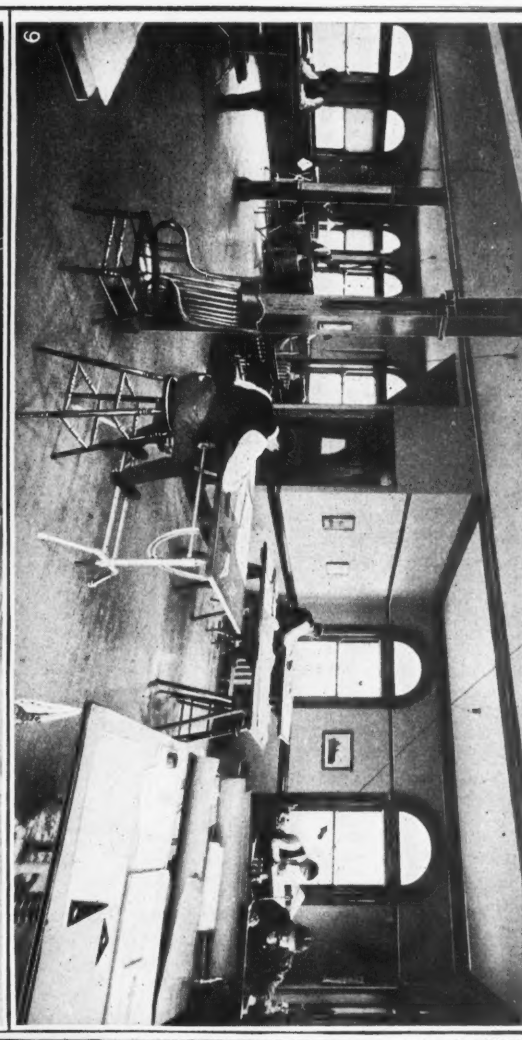
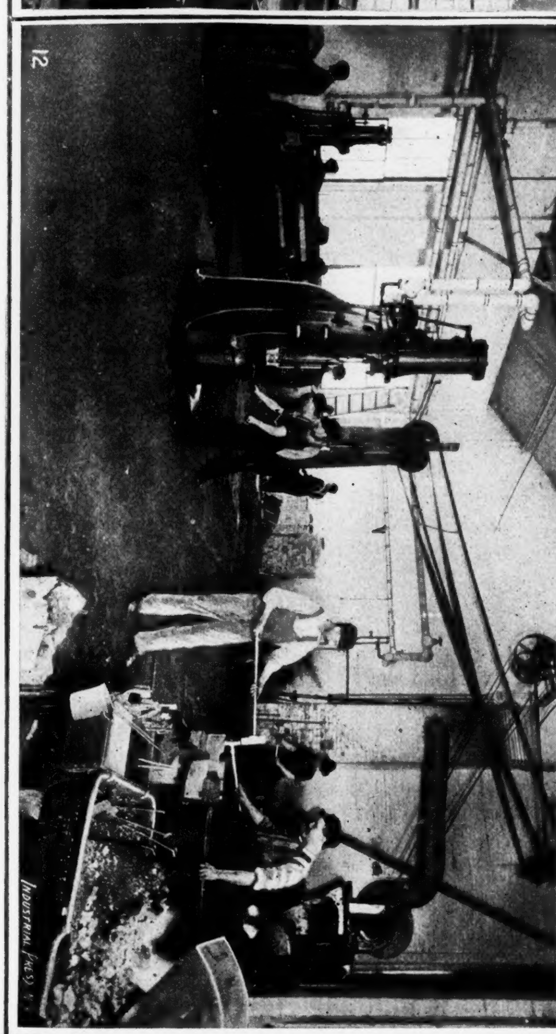


Fig. 9. View in Drawing Room showing Drawing Tables of Special Design.
Fig. 11. View in Main Shop. A Cylinder Drilling and Port Boring Machine is being Erected over the Floor Pit in the Foreground.



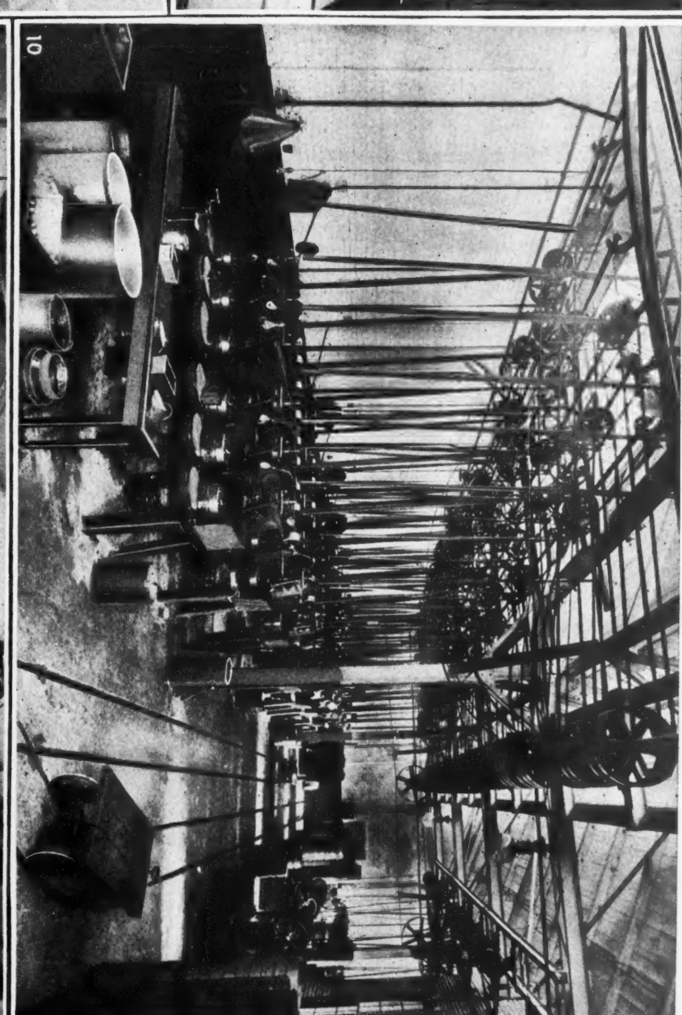


Fig. 10. Grinding Room in Ball Factory.
Fig. 12. View in Blacksmith Shop.

ELECTRICALLY DRIVEN MACHINE TOOLS.—3.

MOTORS APPLIED TO DRILLING MACHINES.

A. L. De Leeuw.

Drill presses are not so often driven by an independent motor as larger machine tools; and, when they are, the difficulties one meets are not so great as with lathes and boring mills. A drill press is generally considered a *handy* tool, except perhaps in manufacturing shops, where the greater part of all the machining done consists in punching a twist drill through a piece of iron. In a great many shops the operations of drilling and tapping do not even find a place in the cost account, and consequently very little money is allowed for improvements in drilling machinery and methods. Drilling and tapping are simply parts of the fitting. This is especially so where the parts to be machined are very large, and where it consequently would not pay to bring the work to the place

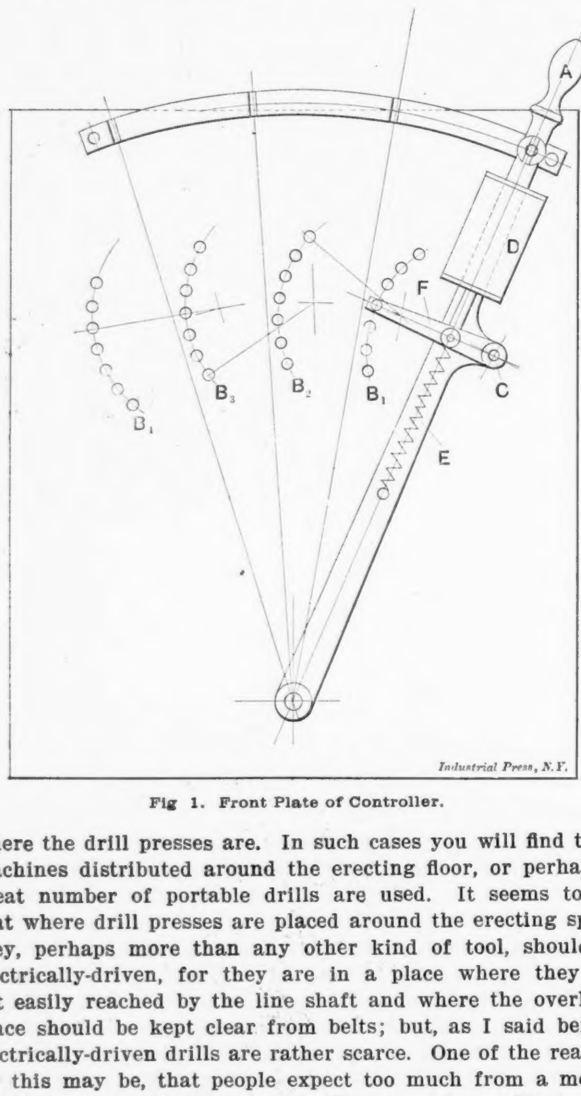


Fig 1. Front Plate of Controller.

where the drill presses are. In such cases you will find these machines distributed around the erecting floor, or perhaps a great number of portable drills are used. It seems to me that where drill presses are placed around the erecting space, they, perhaps more than any other kind of tool, should be electrically-driven, for they are in a place where they are not easily reached by the line shaft and where the overhead space should be kept clear from belts; but, as I said before, electrically-driven drills are rather scarce. One of the reasons for this may be, that people expect too much from a motor, and that the tool builders, so far, have not been able to furnish what, to the lay man, seems a perfectly simple machine. It should also be kept in mind that, when the size of the machine decreases, the relative cost of the motor increases. I remember reading some time ago an article by a well-known writer on technical subjects, in which he expressed his surprise that nobody had thought of simplifying the well-known radial drill, by "sticking a little motor right on top of the drill spindle." I presume if he had tried to do so, he would have been still more surprised.

I will give the result of a rough test of the performance of a six-spindle multiple drill, driven by an electric motor. In this case the motor drove the countershaft, so that the machine can hardly be called a motor-driven machine. The result, however, shows clearly some of the requirements of drill presses.

Six 1¼ inch holes were drilled in a piece of steel, and it was found that the motor took 25 amperes to do this work. It required 3 amperes to drive the machine idle, so that 22 amperes were needed to drill the holes. Next six ¾-inch holes were drilled in the same piece of steel, the drills making the same number of revolutions per minute as the 1¼-inch drills. This required 10 amperes. To run the machine idle, in this case, took again 3 amperes; so that 7 amperes were used for doing the work. Next these holes were drilled out to 1¼ inches, by the same drills as used in the first test, and always with the same number of revolutions per minute of the drill spindles. This required 7½ amperes, or $7\frac{1}{2} - 3 = 4\frac{1}{2}$ amperes for removing the metal. By the last two operations the same result was obtained as by the first operation alone; but the first operation required 22 amperes, while the last two operations together required only 11½ amperes, or practically half as much.

Of course every mechanic knows why this is so. A large portion of the power is required to force the central portion of the drill through the metal. When this central portion is removed, relatively little power is needed to counterbore the hole to size. If a drill press were used only for drilling out of the solid, and not for counterboring, and if the power required were proportional to the size of the hole, then, a series-wound motor might be used successfully; for the speed would have to increase in the same ratio that the diameter of the hole decreases. But neither of the two above-mentioned conditions prevail; a drill press is used at least as much for facing and counterboring as for drilling, and as to the power required for drilling a hole, this is not proportional to the diameter, but more nearly to the square of the same—provided, of course, the drills are making the same R. P. M. regardless of the size of the hole. One might almost reason this out. It is tolerably safe to say, that, given the same feed, the power required to remove metal is proportional to the amount of metal removed; and this is proportional (when drilling out of the solid) to the area of the section of the hole, or to the square of the diameter. That practice does not quite bear out this argument, is probably due to the fact that no attention was paid to the surplus of power used for punching out the central portion of the hole. Referring to our test once more, it will be seen that 22 amperes were needed for six 1¼-inch holes, and if the power were proportional to the square of the diameters, then $9\text{-}25 \times 22 = 7\ 23\text{-}25$ amperes would be needed for drilling six ¾-inch holes. As a matter of fact, however, only seven amperes were needed. One will generally find that proportionally more power is required for small holes than for large ones. That this was not so in this case, may have been due to the greater hardness and sharpness of the smaller drills; though this is only a suggestion.

A series-wound motor is therefore out of the question. To get the variations of speeds necessary for the different sizes of holes to be drilled, and for the different hardnesses of material, any of the schemes mentioned in the previous articles may be applied. For drill presses, another method may also be employed—at least, in a great number of cases—and this is, to use a shunt-wound motor, and control its speed by armature resistance. I have called attention to the fact that a shunt-wound motor loses its valuable quality of having a constant speed under varying load as soon as armature resistance is introduced, and I think it is hardly fair to mention this repeatedly without making some attempt at an explanation. Considering the fact that relatively few readers of this paper have a chance to make a thorough study of electricity, I will have to treat this subject somewhat superficially, and will leave off a number of minor points, which would somewhat modify the following explanation, which I shall put in the form of an example.

Suppose you have a motor, running on a 220-volt circuit, making 660 R. P. M. and taking 55 amperes at full load. Suppose further, that you want to run this motor at half speed, that is 330 R. P. M., and that you want to accomplish this by inserting resistance in the armature circuit. You will get this speed by inserting enough resistance to drop the voltage down to half its original amount—that is to 110 volts—and hence, you must lose 110 volts. This number of volts will be lost, because 55 amperes have to be forced through a certain resistance, and this resistance must be 2 ohms, according to

the law that "current × resistance = electromotive force." We therefore insert 2 ohms in the armature circuit, and the result will be that the motor runs at 330 instead of 660 R. P. M., that is, if the load is 55 amperes.

Fig. 2. Drill with Motor on Top, allowing Arm to Swing through a full circle.

Now suppose the load goes down to, say, 10 amperes. These 10 amperes are forced through a resistance of 2 ohms, and consequently, the loss of voltage is $10 \times 2 = 20$. The remaining voltage available for running the motor is now 200, and the motor speed will therefore be $\frac{200}{220} \times 660 = 600$ R. P. M. It will be seen that the speed has gone up from 330 to 600 when the load decreased from 55 amperes to 10 amperes and this is not at all unreasonable, where a motor drives a machine tool. If you should want this same motor to run at half speed, with a load of only 10 amperes, you should have inserted another amount of resistance, which amount should be $\frac{110}{10} = 11$ ohms. It is plain, therefore, that every new load requires a new amount of resistance, and that this resistance should be increased automatically, as soon as the load goes down if the motor is to be used for driving a machine tool. There is no rheostat or controller that I know of that will accomplish this object, although there is no reason why there may not be one some day.

Fig. 3. Duplex Radial Drill with Horizontal Motors on Tops of Columns.

The following is an outline of a method by which this result might be obtained. Fig. 1 is a diagrammatic sketch of the front plate of a controller which is designed to automatically insert the resistance necessary to keep the motor down to the speed it is intended to have. A is the controlling lever; B_1 B_2 B_3 B_4 a set of contacts, each of which inserts a certain amount of resistance in the armature circuit. B_1 is the lowest of a set of buttons, arranged in the arc of a circle. In the position of the lever shown in the figure, this arc is struck from the center C, which center is the pivot of a lever operated by a solenoid D. This solenoid, as well as the lever and its fulcrum C, is carried by the main controlling lever A; it has a very low resistance, and is in series with the armature, so that the same amount of current which flows through the armature, also flows through the solenoid. The strength of the solenoid, therefore, increases with the amount of current used by the motor. The solenoid tries to lift the little lever against the resistance of a spring E, also carried on the main controlling lever A. It follows, that the lever F will occupy the highest position when the maximum current flows through the armature, and that with no load it will be in the lowest position, as shown. (*No load* does not mean *no amperes*, because a certain number of amperes are always required to run the motor itself.) There are a number of buttons between these two positions, each of which will insert as much resistance in the armature circuit as is necessary to make the motor run at the same speed as at full load. Each of the different sets of buttons B_1 B_2 B_3 B_4 represents a different speed at which the motor is to run, and a sufficient number of buttons is placed in each series to make the gaps so small as not to be objectionable.

Though this, or a similar device, would overcome the difficulties arising from instability of speed, it does not do away with the fact that armature resistance in the circuit involves a great waste of power. For instance, half the power given to the motor is wasted when running at half speed; one third is wasted when running at two-third speed, etc. There are many cases, however, where this waste of power could be tolerated, if variable speed could be obtained. Furthermore, it should not be forgotten that if a motor were controlled on this plan, say with a speed range of 1 to 2, and, say ten horse power were required at the lowest speed, a twenty horse power motor would have to be installed.

To come back to our sheep, I said that a shunt-wound motor with armature control might be used for drill presses, at least in a great many cases. This is due to the fact that the resistance when drilling is practically constant; even when a drill is used for boring out small cored holes in a casting, the resistance, though not constant, varies so little that the speed remains near enough constant for practical work. There is one point, however, which ought to be figured against the use of armature control, and that is, that the operator would

have to keep his hand at the controller until the drill has a fair start, which would be a rather serious drawback.

A number of designs of electrically-driven drills—horizontal, upright and radial—are in existence. The radial drill is obviously the most awkward machine to fit a motor to, for the power has to go around so many nooks and corners that it is hard to determine just where to apply the motor. The most practical place, perhaps, is at the base of the column, if the drill is not intended to work over a complete circle, or on top of the column, where the arm is to swing clear around. Such a drill is illustrated in Fig. 2. It is a Niles drill, with a Northern Electric Co. motor on top. As will be seen, the motor is of the vertical type; it drives a vertical shaft, which otherwise is driven from the countershaft, and the ordinary cones and back gear are preserved, so that a constant speed motor can be used. Switch and rheostat are mounted on a board at the foot of the column. This, however, is not the ordinary construction; they are commonly placed on top of the column and against the motor. Cords, hanging down to about five feet above the sole plate, are used to operate the controlling mechanism. Fig. 3 shows a duplex radial drill, with Western Electric motors on top. These motors are of the horizontal type, and do not allow of such a symmetrical construction as the vertical motor. Besides, being placed out of center with the column, the motor is apt to cause the column to vibrate.

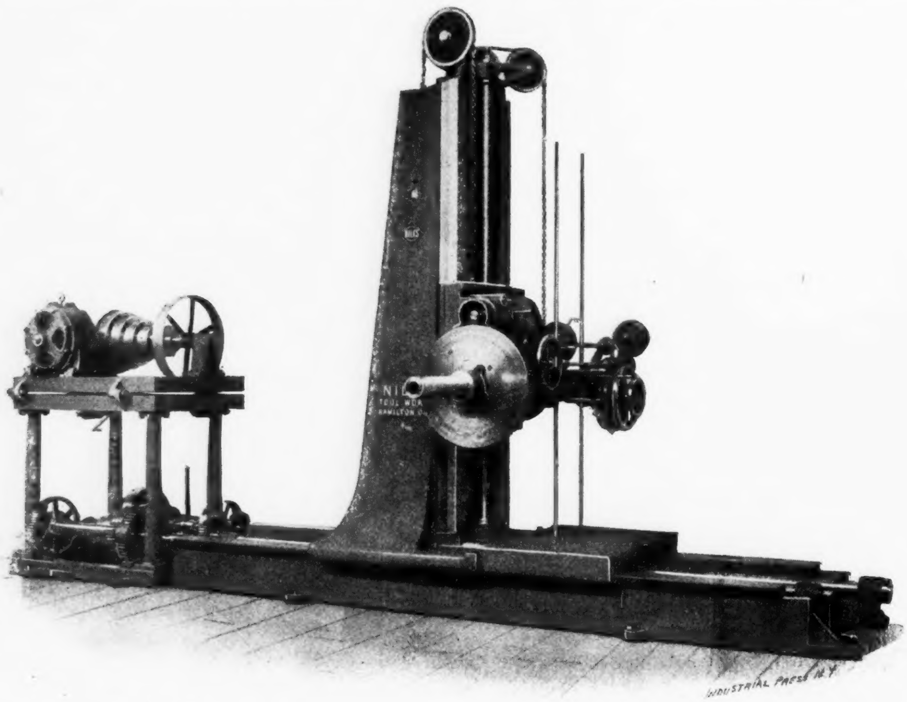


Fig. 4. Horizontal Boring, Drilling and Milling Machine; Constant-speed Motor; Belted Connection.

Another application of the motor to a drill press must be mentioned here, an example of which the writer saw in the shops of the General Electric Co. at Schenectady, N. Y. The drill press was driven by a motor operated on the Edison three-wire plan. This is really a kind of multiple voltage system, in which two dynamos each furnish a pressure of, say, 110 volts. By using these two voltages in series one gets 220 volts. The General Electric Co. motor used for this drill press had a large amount of field regulation, and in this way a great range of speeds was obtained. The outfit for controlling this motor consisted of two switches, a starting rheostat and a field rheostat, and required a good deal of handling. It is obvious, however, that all this mechanism might have been assembled in one box and worked by one handle, and it could then have been used, not only for running the motor at different speeds, but also for the purpose of giving the drill a quick backing motion for tapping. This was, in fact, the work I saw being done on the machine. The numerous switches and rheostat, however, made it necessary to have two operators when tapping. Where the Edison three-wire system or the multiple system are not used a similar result may be obtained by providing the rheostat of a constant speed motor with sufficient resistance to cut the speed in two. The low speed can then be used for tapping, while cutting out the resistance and at the same time reversing the current will give the backing motion to the spindle. This is one of the cases where loss of current would not be objectionable.

Boring machines are nothing but lathes for internal turning, and where the work is stationary. A boring machine has the same requirements, as to speeds and power, only the range of speeds is generally much more limited. A boring machine which will bore a 30-inch hole is not supposed to drill a 2-inch hole; but a 30-inch lathe certainly ought to be able to turn a 2-inch piece or bore a 2-inch hole. The problem of applying a motor to a boring machine, therefore, is a much simpler one than the direct electric drive of a lathe. It generally is, in the main, a question of room and of arrangement of parts. There are, however, what might be called combination machines—machines which are intended for drilling as well as for boring, and in such cases one has to look for the same difficulties as with the lathe. Figs. 4, 5 and 6 show examples of such machines, with different styles of electric drives. Fig. 5 is a large horizontal boring, drilling and milling machine, driven by a motor with a range of speeds as large as the range of speeds of the cone which ordinarily drives this machine. Nothing had to be done, therefore, but attach the motor to the machine and gear it to what might be called the cone sleeve, so as to get the proper speed. One will notice a pulley on an extension of the motor shaft; this serves to give a quick traverse motion to both column and saddle.

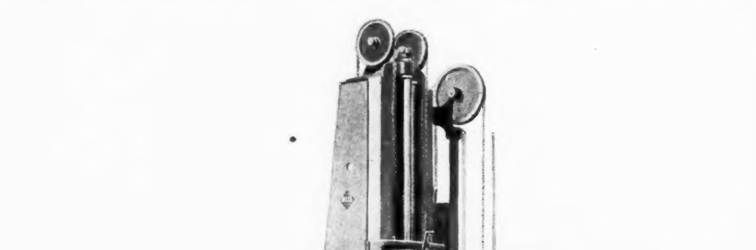


Fig. 5. Machine similar to that in Fig. 4, with Variable-speed Motor having a Wide Range of Speeds.

Fig. 6 shows a similar machine, driven by a motor with a rather limited amount of speed variation. This motor is geared again to what might be called the cone sleeve, and two sets of back gears are provided to make up for the lack of speed range in the motor. One can recognize again the quick traverse pulley on an extension of the motor shaft.

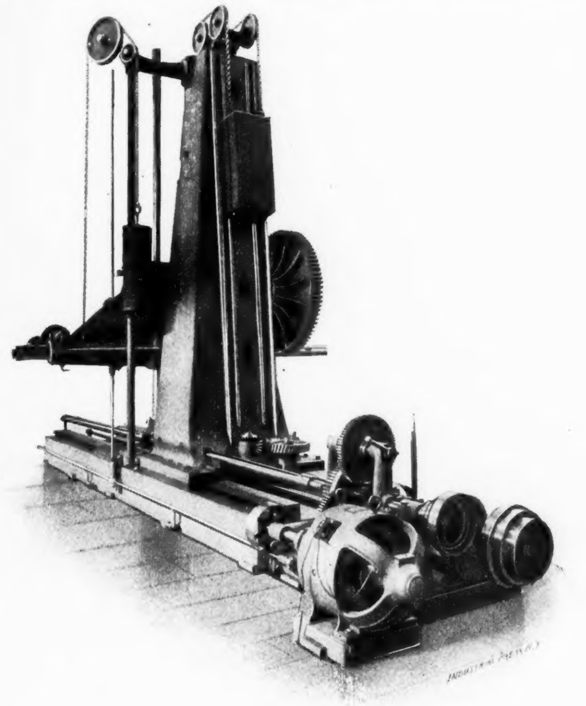


Fig 6. Boring, Drilling and Milling Machine with Motor of Limited Speed Variation and two sets of Back Gears.

Fig. 4 shows a similar machine, driven by a constant-speed motor. In this case the machine is really driven from a countershaft, and this countershaft is driven from a motor. The construction, not to be clumsy, requires a short belt, and this introduces the only difficulty in the case. Everybody, of course, knows how necessary it is to avoid short belts; in fact, some people know it *too well*. As a matter of fact, short belts are not always objectionable. Take the instances of Figs. 5 and 6; short belts were used there for the quick traverse, and they do not cause any trouble. I, myself, have applied belts to a pair of pulleys which only cleared each other by about one inch. There are two reasons why short belts are objectionable in some cases. In the first place, when the belt is to be shifted, like on a planer, the belt should be long, so as to allow speedy shifting. In Fig. 7 A represents the countershaft pulley, and B_1 and B_2 the machine pulleys. C is the belt eye, which is shown in the act of shifting the belt. This belt eye is, of course, close to the lower pulleys, and consequently the lower portion of the belt is shifted first. The belt, therefore, stands at an angle to the vertical line, and must, therefore, be stretched. If the distance between the pulleys is small this angle, and with it the amount of stretch, must be greater than when the pulleys are far apart. This stretch makes necessary a heavy pressure of the belt eye against the belt, and might be great enough to cause the belt to double up instead of shifting. The wider the belt the more marked this effect and the farther apart the pulleys have to be placed. The second case, when pulleys should not be close together, is when one pulley is much smaller than the other. Fig. 8 is an exaggerated case of this kind. The adhesion of the belt to the pulley depends on different conditions. In the first place there is the surface of the pulley; in the second place, the tension in the belt, and in the third place, the arc of the pulley covered by the belt. In the case of Fig. 8 this arc is very great for the large pulley, and very small for the small one, which is just the reverse of what it ought to be. The leverage on the small pulley being smaller, the arc of contact ought to be larger. Where it is necessary to have a short center distance between the pulleys, one covers the pulley or belt with some adhesive substance or one uses an idler pulley as in Fig. 9 for the purpose of increasing the arc of contact, or else one increases the tension of the belt. This last remedy is, of course, to be applied with some common sense, for increased tension in the belt means increased pressure on the bearings and heavier load on the shafts. There are cases, however, where it is the only remedy at hand, as, for instance, where cone pulleys are used. To increase the adhesive quality of pulley or belt would increase the tractive power of the belt, but would make it difficult at the same time to shift the belt. To use an idler pulley would, of course, be possible, but would mean complications in the mechanism; for each pair of steps of the cone pulley would mean a different position of the idler pulley. It is, therefore, obvious that the only remedy left is increased tension of the belt. This, however, makes the shifting difficult, unless some means are used to quickly relieve the tension whenever one wants to shift the belt from one step to another. This is accomplished in the machine shown in Fig. 4 by placing countershaft, with motor and all, on a plate which is hinged and can easily be lifted by means of a worm, worm wheel, and a pair of cams. A single turn of the worm shaft relieves the belt tension sufficiently to enable the operator to shift the belt, after which a turn in the opposite direction tightens the belt sufficiently to run the machine. Of course, the tension of the belt should not be so high as to cause too much pressure on the bearings, and, therefore, even with the mechanism described just now the distance between the two cones should not be too short.

A short center distance between the pulleys is not objectionable where the belt is not to be shifted, and where the pulleys are of the same or nearly the same diameters, and especially not if the belt runs vertically. In fact, in the latter case a short belt is preferable.

It may be mentioned here that a somewhat similar drive is often used for electrically-driven lathes, especially in Germany and Switzerland, where the prevailing tendency is to use two or three-phase motors (constant speed, of course). Two different schemes are used. In one case the motor is geared to a countershaft, which carries the cone. Motor and countershaft together are placed on a hinged plate, so that

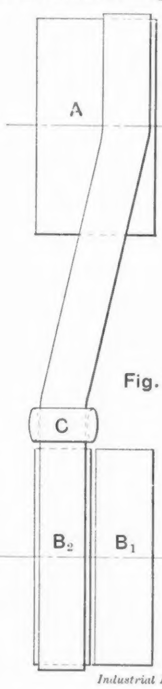


Fig. 7

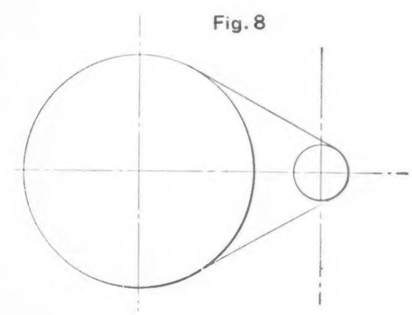


Fig. 8

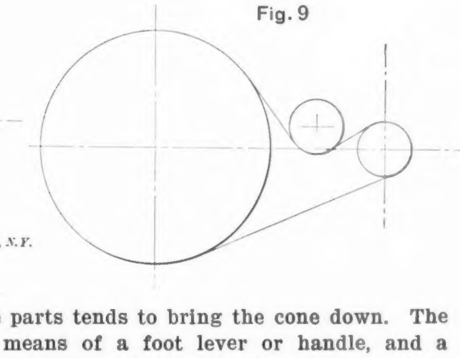


Fig. 9

the weight of these parts tends to bring the cone down. The plate is lifted by means of a foot lever or handle, and a catch holds it in the lifted position until released. The whole apparatus is placed directly under the headstock of the lathe and just a little distance above the floor. This arrangement not only makes it possible to shift the belt, but it also maintains a constant tension. The second mode of driving is similar to the one described above, except that the motor

alone is placed on the hinged plate, and is belted to the countershaft which is placed at the rear of the lathe and high enough to allow the belt to pass from one cone to the other without going through the bed. The countershaft is held in two swinging arms, so that the weight of the motor and plate provides the necessary tension between motor and countershaft as well as between countershaft and machine. This matter of constant tension in the belt is not so good, however, as it looks. The belt is apt to quiver and jump when an irregular cut is taken, and causes the lathe to develop the minimum power just when the maximum is required. For this reason it seems preferable to have some positive means of holding the plate; for instance, such an arrangement as shown in Fig. 6.

* * *

NEW SELF-HARDENING STEEL.

Wm. Jessop & Sons, Limited, of Sheffield, England, have introduced an entirely new type of quick-speed self-hardening steel, for which the following advantages are claimed:

Uniformity and easy manipulation with the best working results in shop practice. Instructions for working are particularly simple, and no elaborate process of hardening is required. The tool to be forged is heated uniformly to a bright red, forged to shape and allowed to cool.

To harden, place the nose of the tool in the fire and heat to a good white heat. Allow to cool away from the hearth and thoroughly remove, by grinding, the thick scale which results from this high temperature. After the tool has been ground four or five times to get the best possible results it is found advisable to reharden, without, however, dressing the tool in any way.

This steel has been thoroughly tested on cast iron and steel forgings of all kinds, and the following is a typical test: A marine shaft 12 inches diameter, carbon 0.30 per cent, was put in the lathe. A 1½-inch square tool was used, with a cut of ⅜ inch (that is, reducing shaft ¾ inch in diameter). Longitudinal feed 4 to the inch. Cutting speed 30 feet (the belting and lathe would not do more). Tool ran 24 hours before grinding. Weight of cuttings per hour 80 pounds. Jessop's American headquarters are at 91 John St., New York.

GEARING.—2.

CALCULATIONS FOR STRENGTH AND POWER TRANSMITTED—DRAWING THE TEETH.

C. F. Blake.

Before proceeding further it is well to know if our assumed pitch for the gears will give strong enough teeth without requiring a wider face than is practical, and it becomes necessary to know the force or power transmitted by

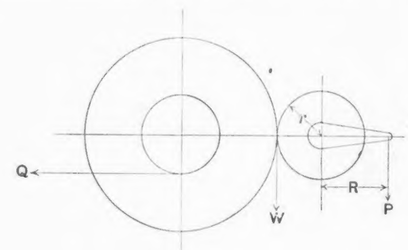


Fig. 5.

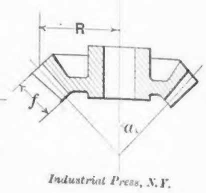


Fig. 6.

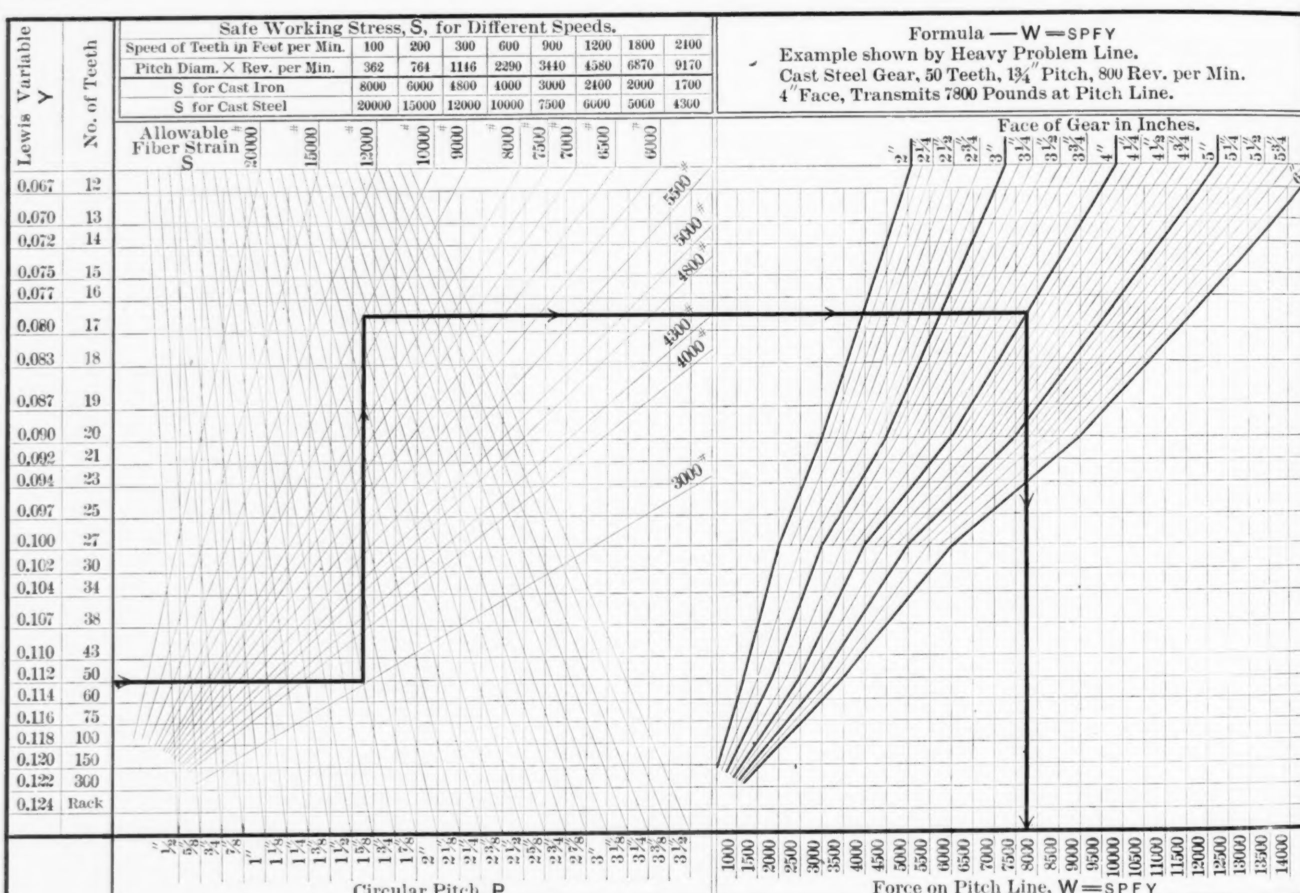
the gears. The most convenient way to do this is to get the force in pounds which is carried by the gear at the pitch line. In Fig. 5, let it be supposed that the power ratio is such as to make it just possible to move the load Q with a force P upon the crank. Then the force W at the pitch line of the gears will be,

$$W = \frac{P R}{r}$$

Having found W we may calculate the required width of face for our gears having the assumed pitch, and if the required face proves to be too wide we shall have to assume a larger pitch, in order to get stronger teeth. The most widely used formula for the strength of gears is that proposed by Mr. Wilfred Lewis and given in Kent's handbook, page 901, as

$$W = S P F Y,$$

This article is complete in two installments and places in convenient form for reference the information upon gear wheels most often needed by draftsmen.—Editor.



Safe Working Stress, S, for Different Speeds.

Speed of Teeth in Feet per Min.	100	200	300	600	900	1200	1800	2100
Pitch Diam. × Rev. per Min.	362	764	1146	2290	3440	4580	6870	9170
S for Cast Iron	8000	6000	4800	4000	3000	2400	2000	1700
S for Cast Steel	20000	15000	12000	10000	7500	6000	5000	4300

Fig. 7. Chart for the Calculation of the Strength of Spur Gears.

in which W = force on pitch line in pounds,
P = circular pitch,
S = allowable fiber strain for the material used,
Y = variable in table.

S may be assumed as 3,500 pounds for cast iron and 8,000 pounds for cast steel, and as the pitch has been already assumed, the formula may be changed to give the required width of face thus,

$$F = \frac{W}{S\ P\ Y}$$

Substituting in this formula the values already obtained for W S P and Y, we find the required face for the gears, and if

Table II.

Radial Flanks,		Involute 15°.	
Number of Teeth.	Factor Y.	Number of Teeth.	Factor Y.
12	.052	38	.107
13	.053	43	.110
14	.054	50	.112
15	.055	60	.114
16	.056	75	.116
17	.057	100	.118
18	.058	150	.120
19	.059	300	.122
20	.060	Rack	.124
21	.061		
23	.062		
25	.063		
27	.064		
30	.065		
34	.066		

this is too great, a larger pitch must be used. The formula given by Mr. Lewis for bevel gears is

$$W = S\ P\ F\ Y \frac{d}{D}$$

where d and D are the pitch diameters at the small and large ends of the teeth respectively. This may be reduced to the form

$$W = S\ P\ F\ Y \frac{R - F\ sin.\ a}{R}$$

where R is the pitch radius at the large end of the teeth, and a is half the pitch cone angle as shown in Fig. 6. This form will often be found the more convenient in use, and for miter gears becomes

$$W = S\ P\ F\ Y \frac{R - .707\ F}{R}$$

The accompanying charts, Figs. 7 and 8, for the strength of

Table III.

Circular Pitch.		Diametral Pitch.
0 3 × pitch.	a	1 ÷ pitch.
0.4 × pitch, below 1″.	b	1.15 ÷ pitch.
0.375 × pitch, above 1″.	b	
0.016 × pitch diameter.	c	0.016
0.53 × pitch.	S	
0.47 × pitch.	T	
0 1 × pitch.	f	

Multiply by Number of Teeth.			Multiply by Number of Teeth.		
Pitch.	A.	B.	Pitch.	A.	B.
3/4″	0.03	0.015	1″	0.125	0.062
7/8″	0.035	0.0175	1 1/4″	0.100	0.050
1″	0.04	0.02	1 1/2″	0.083	0.041
1 1/8″	0.045	0.0225	1 3/4″	0.071	0.035
1 1/4″	0.05	0.025	2″	0.062	0.031
1 3/8″	0.055	0.0275	2 1/4″	0.056	0.028
1 1/2″	0.06	0.03	2 1/2″	0.050	0.025
1 5/8″	0.065	0.0325	2 3/4″	0.045	0.022
1 3/4″	0.07	0.035	3″	0.042	0.021
1 7/8″	0.075	0.0375	3 1/2″	0.036	0.018
2″	0.08	0.04	4″	0.031	0 015
2 1/8″	0.085	0.0425	5″	0.025	0.012
2 1/4″	0.09	0 045	6″	0.021	0.010
2 3/8″	0.095	0.0475			
2 1/2″	0.100	0.05			

Odontograph Table giving Dimensions shown in Fig. 10 in terms of the Pitch.

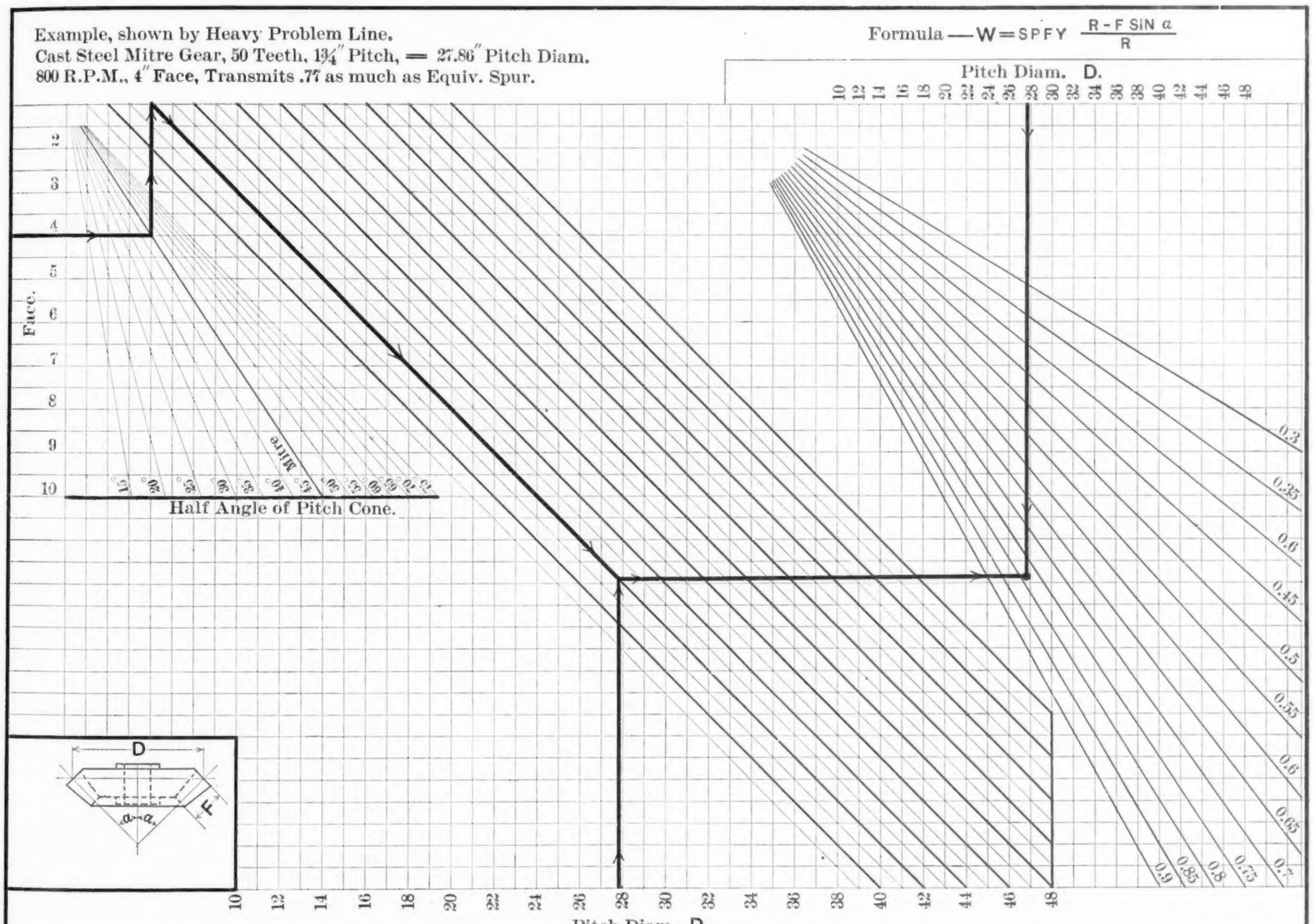


Fig. 8. Chart for the Calculation of Bevel Gears, to be used in combination with Fig. 7.

spur and bevel gears enable problems to be solved easily and quickly, and the result of any changes in pitch or face to be quickly seen. Fig. 7 is for spur gears, and the heavy line with arrows shows the method of working out the problem of the 50-tooth gear as stated in the upper right-hand corner of the chart. The chart also shows the safe working loads for different speeds as given by Mr. Lewis. Enter the chart on the left at the number of teeth; then follow over to the diagonal line for the pitch of the gear, then up or down to the diagonal line for the allowable fiber strain for the material of which the gear is to be made, then over to the diagonal line for the face of the gear, then down and read the load in pounds that the gear will carry at the pitch line. If the load to be carried and the number of teeth required are known, the chart may be entered at each end, that is, at the number of teeth and at the load, and by then following each way the face required for a certain pitch, or the pitch required for a certain face are easily seen, and thus the best combination of face and pitch for any case is easily determined without any calculations.

Fig. 8 is to be used in combination with the first chart for the calculations of bevel gears. It will be noticed that the formula for spur gears is the same as the first part of the formula for bevel gears, so the first chart is used to work out this part of the formula while the second chart is used to work out the second part of the formula, and the results obtained are to be multiplied together for the final result. It will be seen that the fractional part of the formula will always be a decimal, and that consequently any bevel gear must be weaker than a spur gear of the same pitch and face. This would be expected also from an inspection of the two styles of gears, as while the teeth of a spur gear are of the same thickness all across the face, the teeth of a bevel gear taper, and are of the same thickness as the spur gear only at the large end. It is this decimal, expressing the strength of the bevel gear in terms of the strength of a corresponding spur gear, that is given by Fig. 8.

As in Fig. 7, the heavy line in Fig. 8 indicates the working out of the problem given on the chart, which is the same as the problem on the first chart, only that the gear is a bevel gear. The bevel gear chosen for the problem is what is called a miter gear; that is, one of a pair of bevel gears having equal diameters with the shafts at right angles. Half the pitch cone angle is 45 degrees in this case. Enter the chart at the left with the face, follow over to the diagonal line for half the pitch cone angle *a*, then follow up to the top of the chart and then down the nearest diagonal until directly over the pitch diameter given at the bottom of the chart; from here follow over until directly under the pitch diameter given at the top of the chart. Read at the right of the chart the decimal value of the nearest diagonal line, in this case 0.8; multiply the result obtained on the first chart by this result for the strength of the bevel gear. The use of these charts is much simpler than the explanation can be made to appear, and will become easy after a few problems have been worked out.

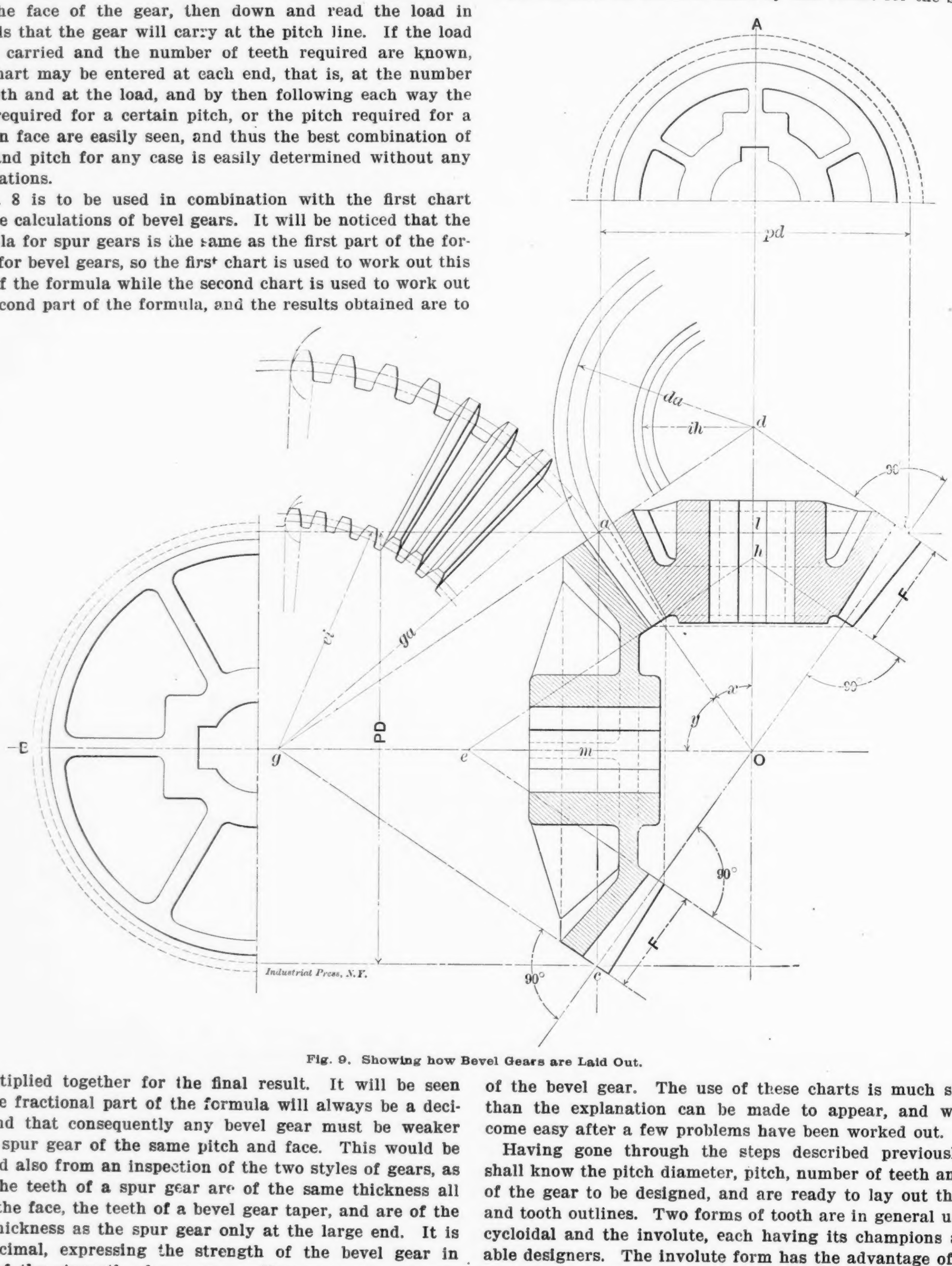


Fig. 9. Showing how Bevel Gears are Laid Out.

Having gone through the steps described previously, we shall know the pitch diameter, pitch, number of teeth and face of the gear to be designed, and are ready to lay out the gear and tooth outlines. Two forms of tooth are in general use, the cycloidal and the involute, each having its champions among able designers. The involute form has the advantage of being the more easily ground to an approximately correct tooth form in the case of molded gears, and of running well with a small deviation from the true distance between centers. The involute form only will be considered, as it is believed that this form is becoming very much the more common of the two. The tooth outlines are most conveniently laid out by the

use of an odontograph table (table III.) in which the dimensions shown in Fig. 10 are given in terms of the pitch. Two gears are shown in mesh with a rack—that on the left showing the method of laying out a gear having from 12 to 36 teeth, and that on the right showing the method for a gear having 36 teeth or more.

When starting to lay out a gear, first draw the pitch circle of a diameter equal to the pitch diameter previously determined. Draw the point circle outside the pitch circle, and a distance from the pitch circle of 0.3 times the pitch and draw the root circle inside the pitch circle and a distance from the pitch circle of 0.4 times the pitch. These two distances are given as a and b respectively in Fig. 10 and in Table III. it will be seen that as the point is 0.3 of the pitch outside the pitch circle while the root is 0.4 of the pitch inside the pitch circle, the teeth of the two meshing gears will have a clearance between point and root of 0.1 of the pitch. For gears having greater than 1 inch pitch, this clearance will be greater than necessary even for rough gears, and will not look well; so for gears above 1 inch pitch 0.375 instead of 0.4 may be the multiplier for the pitch, as will be found noted in the table. The base line is now drawn at a distance 0.016 times the *pitch diameter* from the pitch circle. This base line may sometimes come inside the root circle. The pitch is then laid off upon the pitch circle as before described, and the spaces thus made upon the pitch circle are to be divided into tooth and space parts. The tooth part will be 0.47 times the pitch, and the space part will be 0.53 times the pitch, thus giving the tooth a small clearance in the space. We are now ready to draw in the tooth outlines, which are circular arcs drawn from centers on the base line. In the case of a gear of less than 36 teeth the tooth outline will be composed of two arcs, while for all gears of 36 teeth or more the tooth outline is only one arc. The radii for these arcs are found by multiplying the number of teeth in the gear by the constants found in the odontograph table opposite the pitch of the gear. These radii are designated in Fig. 10 and Table III. as A and B. In the case of gears of less than 36 teeth the tooth outline is completed by radial lines as shown in Fig. 10.

Bevel gears are used to drive intersecting shafts, and are portions of cones having the teeth upon the conical surface. Bevel gears are always designed and used in pairs, that is, under ordinary conditions there can be no series in which each gear will mesh and run with any other gear. These gears are laid out as follows, referring to Fig. 9:

Having determined upon the respective pitch diameters PD and pd, draw the axes AO and BO. Lay off upon these axes the pitch radii Ol and Om. Through l and m draw the pitch diameters ab and ac. Draw the pitch cones abO and acO, and the back cones abd and acg, with sides at 90 degrees with the pitch cones, as shown. Lay off the width of face f upon the pitch cone lines, and draw eih through i parallel to gad. From centers g and d draw pitch circles with radii ga and da respectively; upon these pitch circles are to be laid out the tooth forms, and *not circles* of radii al and am, as might be supposed.

The actual circular pitch of the gear, as calculated for the pitch diameters PD and pd, is to be laid off upon the pitch circles as drawn. The tooth parts are then to be found from table III. as if they were spur gears of the *same pitch*. *The number of teeth* to be used in connection with the odontograph table *is not*, however, the number of teeth N and n of each gear, *but a formative number of teeth* N_1 and n_1 to be found from the formula

$$N_1 = \frac{N}{cos.\, y} \qquad n_1 = \frac{n}{cos.\, x}$$

To obtain the dimensions for the tooth parts at the smaller ends of the teeth, multiply the corresponding dimensions at the larger end by the ratio

$$\frac{O\,i}{O\,a} = k$$

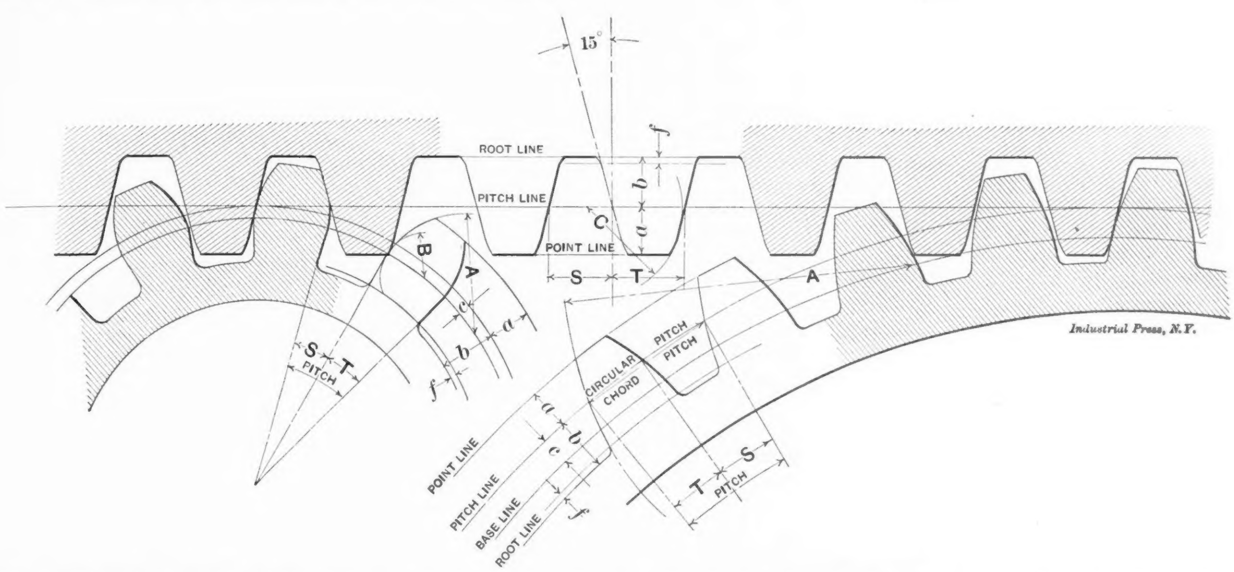


Fig. 10. Two Gears in Mesh with a Rack. The Gear on the left shows the Method of Laying Out a Gear having twelve to thirty-six Teeth; that on the right, a Gear of thirty-six Teeth or more.

ARMOR PLATE TOOLS.

THE METHOD OF FITTING ARMOR AND BACKING TO WAR SHIPS.

ARTHUR MASTERS.

Modern war ships have their structural arrangements very much controlled by the necessity for protecting certain parts by armor, and to increase the resisting power of the target formed by the armored side, the skin or "backing plating" behind the armor is made about twice as thick as the bottom plating, although its situation is frequently not such as to contribute materially to the longitudinal strength of the structure. Even the armor plating itself, though it may be arranged and fastened with the utmost care, must be regarded rather as a load carried by the structure than as adding much to the longitudinal strength of the ship.

For the purpose of insuring a good fit to the armor, and to provide a sufficient length of armor belt, it is necessary to fit "wood backing," and the best material for this purpose is deemed to be East India teak, which is seamed to the plating by galvanized iron or steel bolts ¾ inch in diameter. The backing is first trimmed and fitted in accordance with molds made from the actual armor plates, which have also been made to exact size from molds made from the ship, and the work of laying off the armor bolt holes on the backing is then proceeded with. But these holes, while somewhat larger than the bolts, should nevertheless be practically concentric with the axis of the latter; and in view of the difficulty of attaining this result before the armor plates are fitted, the following method is employed: A set of "centering plugs" with projecting nipples of steel, Fig. 1, is provided, and one of these is fitted snugly into each armor bolt hole in the armor, which has now been received from the armor contractor with the holes already drilled and

threaded to receive the bolts. A skeleton mold is prepared, of the size and shape of the inner surface of armor plate, and laid down on the latter; then by striking the mold with a mallet over each nipple or "centering plug," indentations are made on the mold, the centers of which coincide exactly with the centers of the armor bolt holes. The mold

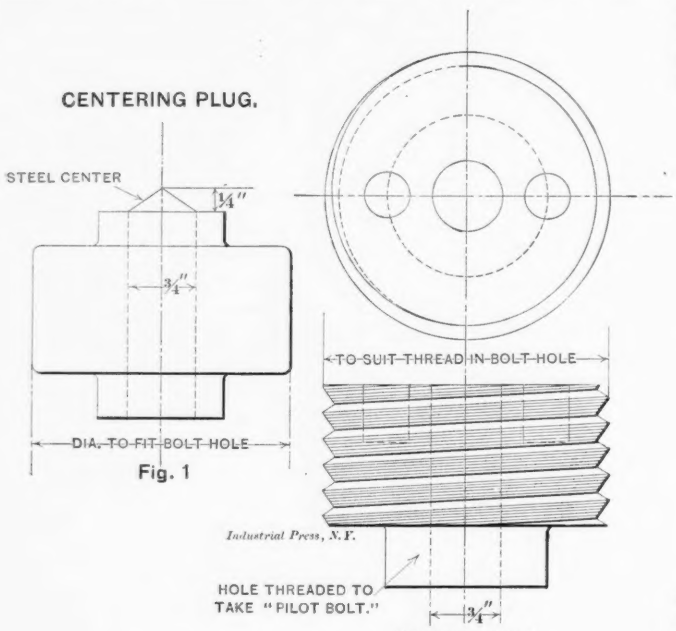


Fig. 1

Fig. 2

is then laid against the wood backing on the ship's side in the exact position that the armor plate will occupy and the indentations are punched through, thus marking the centers of the bolt holes on the backing. "Pilot holes" are then bored through the wood backing and backing plates at the location of each armor bolt, making the same angle with the face of the backing as will be made by the armor bolt. To obtain these angles accurately, all the centering plugs are removed and a threaded "screw plug," Fig. 2, is screwed into each bolt hole.

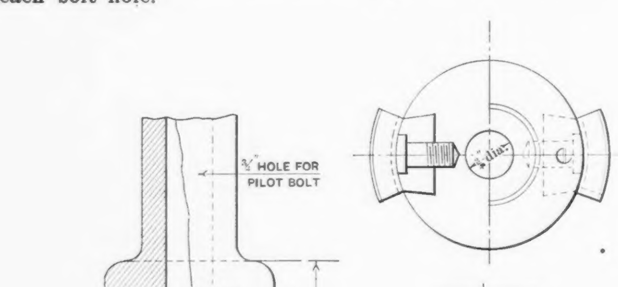


Fig. 3. Steel Cutters.

All the pilot holes for any plate having thus been drilled, the plate is now placed in its proper position against the wood backing and seated firmly against the latter by means of temporary bolts. Pilot bolts are then screwed from inboard into the screw plugs and the holes are bored through the backing plates by tools such as shown by Fig. 3, and which can be used with an ordinary ratchet or pneumatic drill. The holes through the wood backing are then cut by means of cutters, as shown in Fig. 5.

The cutter head is provided with dove-tailed slots for taking various types of wood and steel cutters, as shown. Each of these cutter heads has a central hole of the diameter of the pilot bolt, so as to slip over and be guided by the latter. When the hole has been carried through to the inner surface of the armor the tools are removed and the pilot bolt and screw plug are taken out. The armor bolts are now inserted

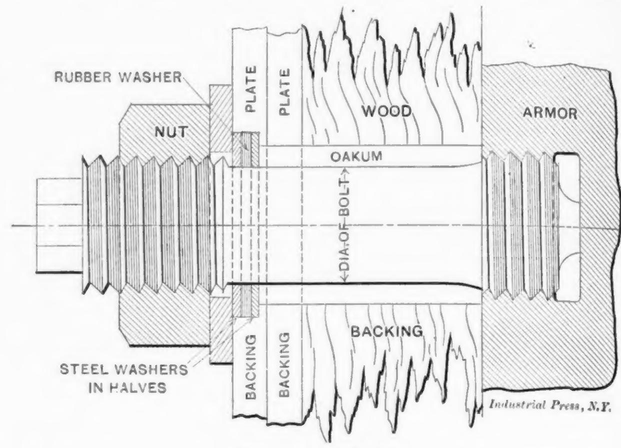


Fig. 4. Armor Bolt.

and screwed hard down to a bearing on the bottoms of the bolt holes in the armor plate, after the latter has been finally fitted in place. Then the plate is drawn up firmly against the wood backing by screwing down the nuts.

The chief peculiarities of these bolts, Fig. 4, are the elastic washer against which the nut is hove up, and the reduced

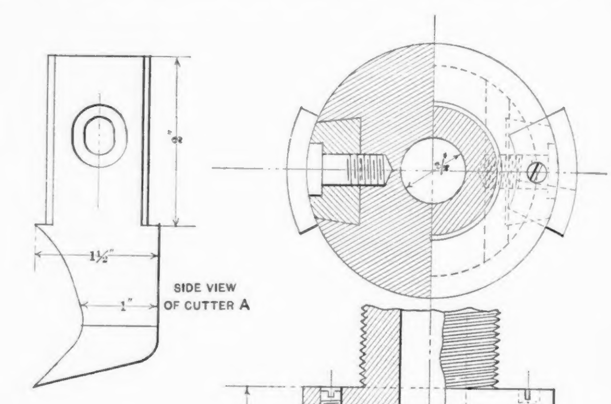


Fig. 5. Wood Cutters.

diameter of the shank. The former, to insure water-tightness, consists of two steel washers, fitted in halves, between which is placed a rubber washer, the total thickness of which is slightly more than the counterbore in the backing plate. The reduced shank is made as long as possible and about equal to the smallest diameter in make of the screw thread. A sudden elongatory strain is brought upon the bolt by the impact of a projectile upon the armor plate, which results in an extension of the bolt at the reduced part, and

thus prevents the fracture at the screw thread. A detail of the screw thread of this armor bolt is shown in Fig. 6, the peculiar angle being specially suitable for resisting the sudden strain above referred to.

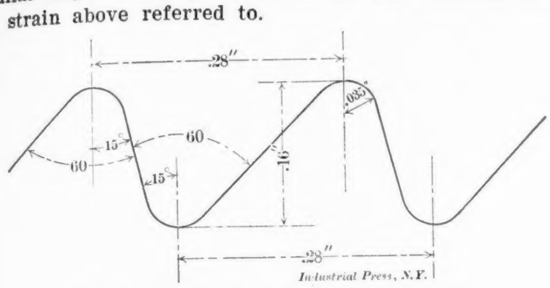


Fig. 6. Enlarged View of Armor Bolt Thread.

While incidental mention has been made of the thickness of backing plating behind armor, it is sometimes necessary to have the backing composed of two plates instead of one, and certain precautions are taken in order to insure water-tightness between the joint of the two thicknesses

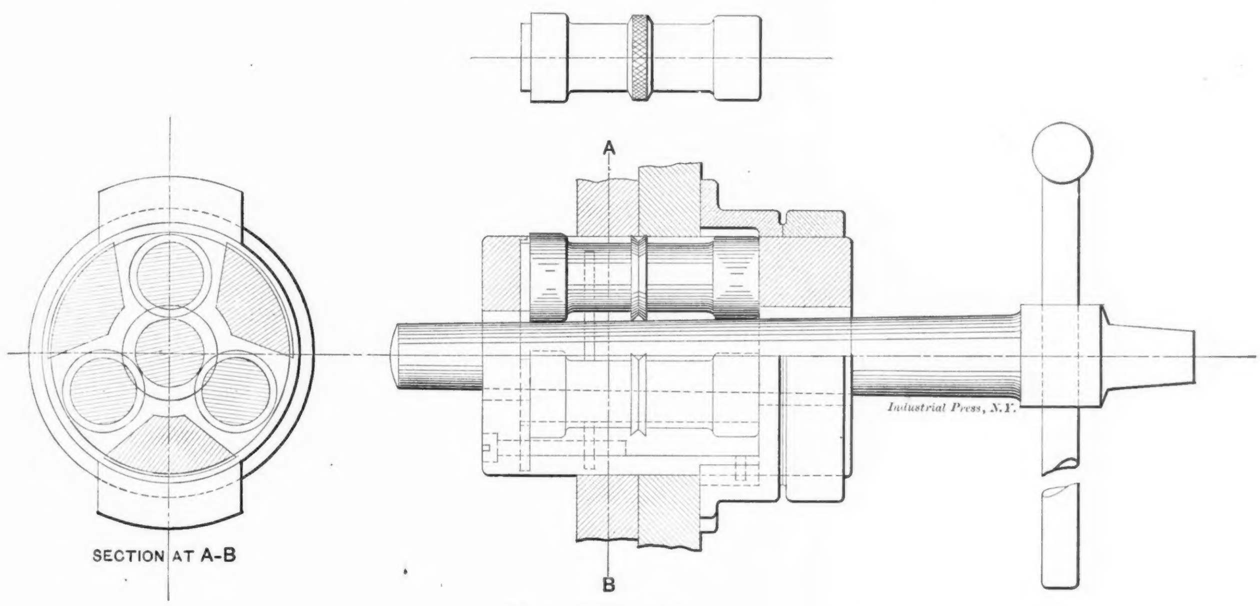


Fig. 7. Cutting Tool.

of plating. The joint is calked, and in order that this may be effectively done, there must have been fitted in advance a number of rivets around each bolt hole to hold the plates together against their tendency to spread when being calked. A convenient method of calking the backing bolt holes is

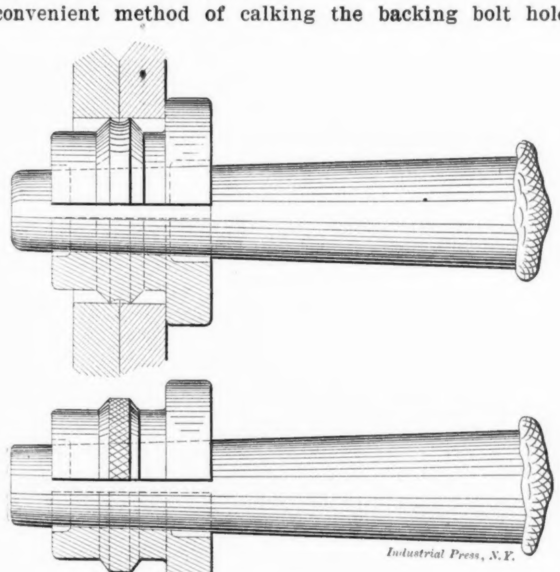


Fig. 8.

shown in Fig. 7. This tool consists of a tapered rod about whose diameter revolve three rollers having cutting edges as shown, and which are kept up to their work by driving up the tapered rod. After the joint is thoroughly calked these rollers are taken out and three others, having milled surfaces, are inserted, the work of these being to finish the hole clean and smooth.

Another tool for this purpose is shown in Fig. 8, which consists of an ordinary drift punch set up through the circular calking tool, which is in halves, the only difference between this and the tool shown in Fig. 7 being that the calking tool is fixed instead of having a circular motion.

The above methods and appliances for fitting armor and their appurtenances are the results of experiments conducted at the various U. S. navy yards and private ship yards, and are considered the best and most efficient in use.

* * *

Almost every lathesman at one time or another has had the job of turning the end of an irregular casting or forging which could neither be carried on centers nor held in a chuck. Such jobs are generally handled by bolting an angle plate to the faceplate and then securing the piece to be turned to the angle plate. This method is usually quite satisfactory except that if the piece is long and heavy it makes a long overhang on the faceplate, especially if the tail center cannot be used to support it. Then the need of a special angle plate with a circular ring attached to its outer end so as to be supported in a steady rest, is felt and sometimes provided where a great deal of such work must be turned. The Billings & Spencer Co. have a number of special lathes for turning irregular drop forgings in which an angle plate forms a permanent part of the faceplate and is supported at a distance of perhaps 18 inches from the faceplate by a steady rest. A circular part is, of course, provided for the outer end of the angle plate to turn in the steady rest. The steady rest forms an integral part of the lathe bed.

* * *

Very few users of emery grinding machinery ever think of the variety of factors entering into the manufacture of emery wheels and the practical impossibility of any manufacturer keeping in stock a complete assortment of all the sizes and grades listed in his catalogue ready for immediate shipment. The principal factors in the emery wheel business are: Diameter of wheel, width of face or thickness, grade of emery, wet or dry; then follow the minor factors of diameter of arbor hole, shape of face, etc. These factors refer in this case only to plain disk wheels and do not include the special wheels such as cup, ring, cylinder, etc. The continued product of the factors first mentioned, giving them the value assigned in almost any emery wheel catalogue, perhaps shows that a stock of millions would be required for one sample of each size and grade. Consequently the best a manufacturer can do is to keep a stock likely to satisfy the average requirement and to fill other orders by approximation and by making special wheels.

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Entered at the Post-Office in New York City as Second-class Mail Matter.

MACHINERY

A Practical Journal for the Machine Shop.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

9-15 MURRAY STREET, NEW YORK CITY.

CHICAGO—1505 MANHATTAN BLDG. BOSTON—620 ATLANTIC AVE.
PHILADELPHIA—MACHINERY FLOOR, THE BOURSE.

DOMESTIC SUBSCRIPTIONS, $1.00 A YEAR. FOREIGN $1.50 A YEAR.
SINGLE COPIES TEN CENTS.

LESTER G. FRENCH, Editor. FRED E. ROGERS, Associate Editor.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Domestic trade is supplied by the American News Company or its branches.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

MARCH, 1902.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers; and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

April	26,000	July	28,964	October	28,345	January	30,021
May	26,500	August	29.492	November	31,743	February	30.146
June	28,000	September	28.165	December	29.237	March	30,084

No other paper in this field prints its circulation figures.

Bona fide inquiries for machinery, appliances and material will be inserted without charge in our weekly report, which reaches all the principal manufacturers in the trade. Address such items to the Information Department, Industrial Press, 15 Murray Street, New York.

* * *

METRIC SYSTEM AGITATION.

The yard is the standard of length in this country, by common consent. The length of the standard yard is based upon the distance between two lines, scratched upon the ends of two gold plugs inserted in a bronze bar. This bar was presented to the United States in 1856 by the British government, and is a copy of a similar standard kept in England and legalized there as the standard yard.

It is probably not generally known, however, that the legal standard in this country is not the yard, but is the meter. In 1856 Congress passed a law making the meter the legal standard of length for this country, and in 1890 copies of the meter and kilogram were received from Paris.

Periodically the question of a more general use of the metric system is agitated and apparently it is slowly gaining ground, although it is difficult to correctly estimate the trend of public opinion with regard to it. The fact that the system is used in physical, chemical and electrical work has undoubtedly influenced other departments of art and science in its favor.

A committee appointed by the Franklin Institute, Philadelphia, to consider the question of the adoption of the metric system, has recently reported in its favor, and there is a bill pending before Congress, providing for the adoption of the metric system of weights and measures by the different departments of the United States Government, which would not only make it the legal standard but would ensure its introduction in the government shops in different parts of the country. Hearings have been given on the pending bill by the House Committee on Coinage, Weights and Measures and for the most part the arguments have been favorable to the metric system which is accounted for, probably, by the fact that most of the testimony has been given by scientists instead of manufacturers. It is expected that the bill will be favorably reported by the committee during March.

At a hearing in the early part of February, James Christie, of the Pencoyd Iron Works and American Bridge Co., expressed his ideas in part as follows, as reported by *The Iron Age*:

"It is frequently urged that one of the great difficulties which would arise in our large manufacturing establishments would be over having to change the tools. My idea is that the expense would not be very great, for if I were to introduce the system in my own shop, I would not change the tools at once, but I would simply take the tools as they are and give them a nominal designation in metric units. A tool of one inch I would call 25 mm., and so on with the multiples and subdivisions, and when the tools were out I would have the new ones made to even metric dimensions. Probably for a time we would have two systems of tools, but we would keep the old tools in one department, and the new tools in another, and in the course of a very short time the old ones would disappear. This would not create much confusion. The importance of screw threads I do not think is one of any consequence whatever. The present system is an entirely arbitrary one, and it makes no difference whether we change it or not. There has been an attempt to introduce the metric thread into Europe, but it has not been successful simply for the reason that they never felt they wanted it, and furthermore, while we have a standard screw thread in this country which is almost universally adopted, abroad they have half a dozen different standards. If in the course of time there is an object in changing screw threads and bringing them to the metric system that can be done. * * * I assume it is not the purpose of this bill to compel manufacturers to use the metric system, but simply to make it the only legal system."

So far as the use of the metric system in machine shops is concerned, we believe it is not and never can be as convenient as the English system. The inch, sub-divided into halves, quarters, eighths, etc., is an extremely convenient unit for proportioning machine parts, and when divided into a thousand parts fulfills all requirements for the most delicate and accurate work. No unit of measurement can ever be said to be really convenient unless it can be readily halved and quartered—it is not in the nature of things to divide a thing into fifths and tenths. Nor is the meter, divided and sud-divided by ten into the millimeter, anything like as convenient a length for a unit as the inch. The metric system would undoubtedly be a great time saver for the draftsman who has calculations to make, but not so to the machine constructor.

While an attempt to introduce the system in any shop would result in almost endless confusion at first, this would be a small matter compared with the trials incident to converting the formulas and data now contained in notes, works of reference, textbooks, etc., into the new system. While the trend of things may be away from the English system and toward the Metric system, and the next generation may find many concerns using the metric system, we can see no reason to expect its use in machine shops to any extent until it has first become more of an international system than it now is; and second, until many other departments of science and industry, outside of machine shop practice, have adopted it. Machine shops will not use the system until it has attained a position where it can offer enough advantages in the way of a universal, uniform system to offset its disadvantages and the annoyances and expense incident to a change in standards.

* * *

CARNEGIE'S GIFT TO STEVENS INSTITUTE.

No institution of learning in this country has done more creditable work in proportion to its means and facilities than Stevens Institute of Technology, at Hoboken, N. J. It was founded by Robert L. Stevens, the son of John Stevens, both distinguished for their achievements in navigation, and the latter, also, for introducing the T-rail. The school has been conducted as a school of mechanical engineering, the profession of its founder, and it has sustained the reputation of the Stevens family by turning out a large number of men who rank among the most prominent engineers of the present day. The experimental work and original research done by the instructing staff of Stevens Institute has been quite generally recognized as of a very high order and it is very gratifying that there will now be opportunity to extend the scope of this work, by the completion of a new laboratory of engineering, through gifts by Andrew Carnegie, supplemented by gifts from President Henry Morton. The new laboratory will also give the students advantages in experimental work that Stevens Institute has heretofore not been able to offer.

The presentation by Mr. Carnegie was made on February 6,

and after the ceremonies a dinner was served, which was unique because of the decorations. On the table was a miniature blast furnace from which punch flowed into small ladle cars, which made the circuit of the table. Kegs were distributed containing confections of the form of railway spikes; ice cream was served in the form of T-rails and the oysters were produced from a steel furnace. During the ceremonies President Morton presented to Mr. Carnegie, as a gift from the alumni, a section of the first T-rail ever rolled. It was made under the supervision of Robert L. Stevens at the works of Sir John Guest, in Wales in 1830 and was used on the old Camden and Amboy Railway.

This rail section was enclosed in a solid silver casket, surmounted by the figures of two men working at a rail-mill; on the sides of this box were representations of the first train run on the Camden & Amboy Railway, and on the ends were medallion portraits of Mr. Stevens and Mr. Carnegie. At the four corners of the box were small figures representing an early iron-worker, an armorer of the Middle Ages, a blacksmith, and a Stevens graduate.

In accepting this gift Mr. Carnegie suggested as his own epitaph—"Here lies a man who knew how to get around him men much cleverer than he."

While this in a measure may be the secret of Mr. Carnegie's success, it is only half the truth. He could not have been successful in promoting and managing his vast enterprises had he lacked the sagacity to make well-laid plans and the ability to properly supervise the work of his subordinates. A fullshare of cleverness must be attributed to Mr. Carnegie himself; and not the least evidence of this is the fact of his being clever enough to perceive that to reap the full measure of enjoyment from great wealth one must give liberally and while one is in the land of the living.

* * *

NOTES AND COMMENT.

The Louisiana Purchase, which the world's fair of St. Louis is to commemorate, was probably the greatest real estate deal in the annals of history, and it was brought about by Robert R. Livingstone, who was associated with Fulton in the development of steam navigation. The proposition was made by Napoleon, or his minister, to Livingstone, who was then ambassador to France, and he grasped at the chance of making so magnificent an addition to his country's resources. President Jefferson opposed the purchase on the ground of unconstitutionality, but through Livingstone's efforts the deal was consummated and the whole Mississippi valley and territory tributary thereto were opened up to trade and industry. This purchase marked the first important step in the development of our western territory.

It is announced that within a short time all the big guns undergoing official tests on Sandy Hook will have electricity as a necessary accompaniment. The heavy ordnance will be elevated and lowered by electricity, ammunition will be swung into the breeches by the same power, and in fact all the methods incident to hand power and its accessories will give way to motors, wires and switchboards. The introduction of electricity on Sandy Hook will greatly facilitate the work of testing big guns, and will save in the end thousands of dollars each year for the government. With the installation of electricity Sandy Hook will also have a great improvement in its light; gas lamps will be replaced by incandescent and arc lights. The barracks will be lighted by electricity, together with the fortifications and the grounds exclusively devoted to gun tests. At present the only electrical power on the Hook is used in lighting up the two channel range lights.

The electrical equipment of the Second Avenue Elevated Railroad, New York, is nearing completion. On January 10, 1902 a six-car train with a large number of distinguished engineers and railroad men aboard was propelled by electricity from South Ferry to 129th St. The entire run was made in 29 minutes, part of the way (one-half mile down grade) at the rate of nearly 50 miles per hour. The train was brilliantly lighted with incandescent lights which are distributed throughout the car singly instead of being clustered in groups. The motorman stands in a corner inside of the forward end of the motor car, a glass compartment being provided which shuts him off from the passengers. The power station for the electrical power is situated at 74th Street and East River. It will contain eight of the largest stationary units ever constructed, being Allis engines of 8,000 normal horse power direct-connected to Westinghouse alternating current generators. Both the engine and generator units will stand a load of 12,000 horse power if necessary.

AN OLD CANAL PROJECT.

The attention now being given to an Isthmian canal project by the United States has revived a canal scheme known as the Darien-Mandingo canal which was promoted twenty years ago or more. This canal is the shortest known route, being only 29½ miles long. It would contain no locks or curves and no dams would be necessary to control torrential rivers. Good deep water harbors exist on each side of the isthmus at the terminal points. The great obstacle is that a tunnel through granite mountains, nearly five miles long, would have to be driven. Railway tunnels fall into insignificance when compared to a ship canal tunnel. It would have to be nearly 170 feet high (if the rigging on the largest sailing ships was left undisturbed) and probably as wide, if not wider. The optimistic promoters declare, however, that the canal could be built for $100,000,000 and in four years' time. Electric traction is proposed for drawing sailing vessels through the tunnel and others which would not care to use their own powers of propulsion. It would be ventilated by vertical shafts, the depth of which is not stated. Next!

THE POWER OF HIGH EXPLOSIVES.

The citizens of New York recently had an object lesson of the tremendous explosive power of dynamite in the Subway explosion which wrecked several buildings, killed three men and broke thousands of dollars worth of window glass in the surrounding buildings. The explosive power of nitroglycerine is estimated to be about 300,000 pounds per square inch, and so enormous is this pressure that hard steel flows under it like wax. So sudden and enormous is the pressure from high explosives that the inner surface of shells exploded with "maximite" are flattened and stretched before the fragments can escape from the zone of great pressure. Yet Hudson Maxim says in the *Electrical Age* that if the molten interior of the earth beneath the crust, which is generally believed to be one hundred miles thick, were replaced with nitro-glycerine and exploded, the pressure generated would not be sufficient to lift the crust, but would only be about one-half enough. A cubic foot of granite weighs 160 to 170 pounds. A column of granite one foot square and 100 miles high would weigh, taking a mean of 165 pounds per cubic foot, 87,000,000 pounds. This means a pressure per square inch of over 600,000 pounds, which proves the statement correct.

MACHINERY'S ARTICLES ON ELECTRICALLY-DRIVEN TOOLS.

There is no more live shop topic at the present time than that of electrically-driven machine tools. The use of electricity in machine shops is increasing rapidly, and we shall publish numerous articles upon the subject during the coming year, supplementing those that have already appeared. When an electrical equipment is to be installed in a shop there are a great many questions that must be answered intelligently by some one, but too often a shop man has been so absorbed in mechanical work that he has not had time to keep informed upon the latest electrical practice. Information upon the subject is too scattered—he does not have time to hunt it up—and when found, it is adapted to electrical rather than to mechanical men. As the easiest way out of it he lets the companies who sell the goods answer the questions for him; in fact, he can scarcely do any other way.

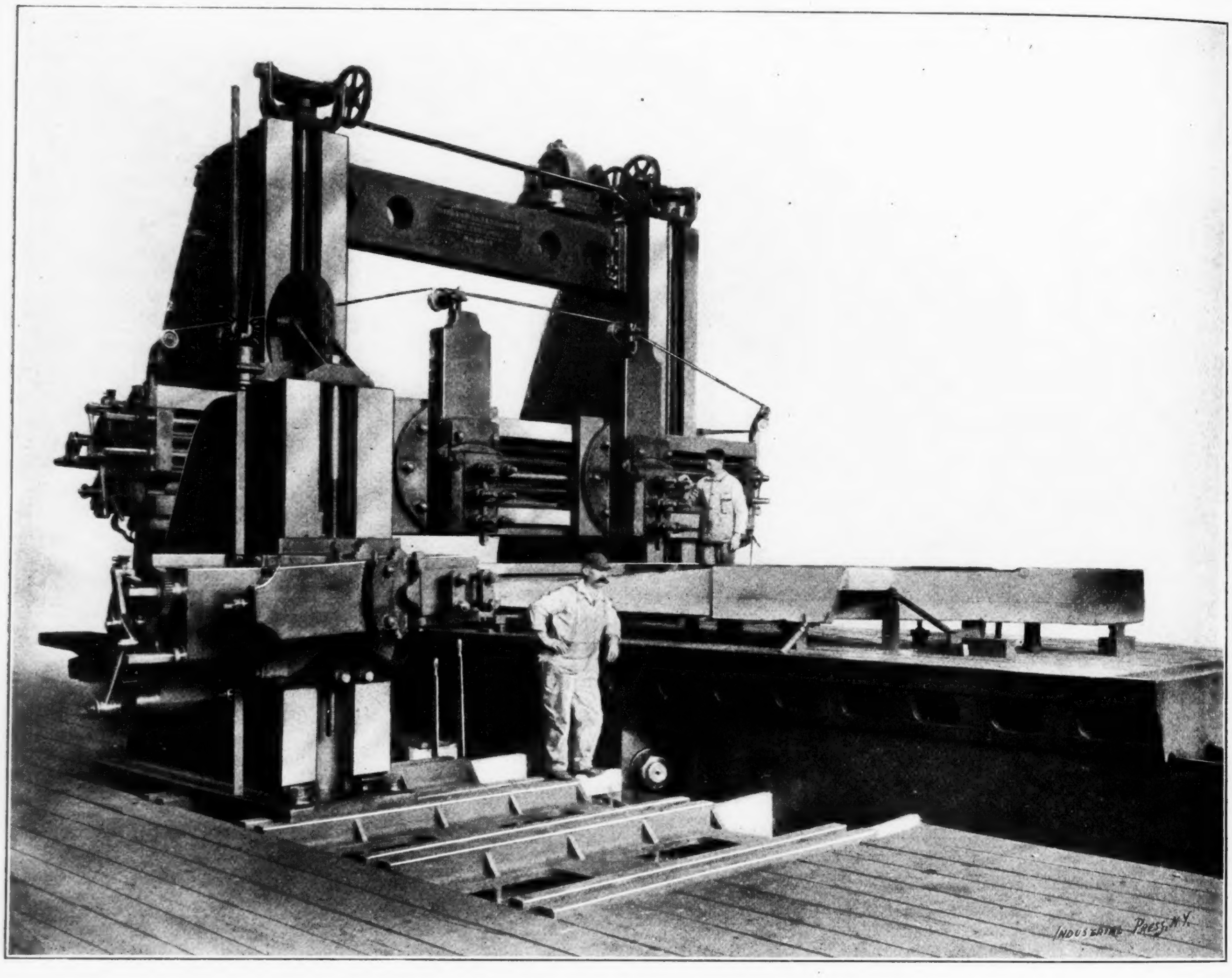
At such a time he will be glad to have the twelve numbers of MACHINERY, for 1902, to refer to. The matter upon electric driving that we are now publishing and that will appear in future numbers will be of material assistance to a person under such circumstances. It will contain in convenient form for reference just the kind of information that will be needed. Save your copies of MACHINERY for 1902.

TWELVE BY TEN FOOT PLANING MACHINE.

The illustration here presented shows an unusually massive and powerful planer, built for the Midvale Steel Co., Philadelphia, Pa., by William Sellers & Co., Inc., Philadelphia. It is designed to take the heaviest cuts on hard steel forgings, and has a capacity between housings of 12 feet and a height of 10 feet, with a table 10 feet wide and 27 feet long, with a working travel of 25 feet. There are two saddles on the cross rail and a vertical slide rest on each upright or housing.

One peculiarity of this planer is that the feeds for each of the four tool holders are independent in direction and amount, each having its own feed motion and crank disk for regulating the amount of feed. To accomplish this, feeding mechanism is mounted on both ends of the crossrail, the two saddles being controlled from opposite ends. Each vertical slide rest carries likewise its own feeding mechanism and all are driven from a common source.

Air pressure is also employed to move the stops in the escapement train which operates the feed motions. It is thus seen that the table does no work in the act of reversing, except to move the small air valves which control the escapement and driving cylinders. The tool clamps on the crosshead are arranged to take tool bars 6 inches square, and the parts are so massive that it is necessary to provide a means of handling them by power. Two series motors are therefore mounted on the projecting ends of the crossrail, which is 42 inches deep and nearly 23 feet long, and by these motors the saddles on the crosshead and the slides on the saddles can be moved to any desired point at a rapid rate and with great accuracy. The crosshead itself is lifted by a 10 H. P. motor, mounted on top of one of the housings, provided with electric brake to prevent the load from running down. The vertical slide rests are counterbalanced, have power feed on the face of the upright and a power crossfeed which may be either horizontal or inclined through a wide angle above and below the horizontal.



Massive Planer built by William Sellers & Co., Inc , Philadelphia.

The bed, which is in two pieces, has a vertical depth of 4 feet 4½ inches, and the ways on the table are flat, 16 inches wide, and 7 feet from center to center. One bearing only is guided. The table is provided with a steel rack of 3-inch pitch, 18-inch face, operated by a bronze spiral pinion on a diagonal shaft 9 inches in diameter. This shaft is driven through a bevel wheel and pinion from a pair of friction clutches operated by a pneumatic cylinder. The action of the stops on the table admits air pressure through either end of the clutch shaft to the proper end of the clamping cylinder, thus causing the alternate engagement and disengagement of the driving and reversing clutches.

The receiving pulley on the machine is 48 x 12 inches, and power is transmitted from the pulley by suitable gearing to the clutches, the train to the forward motion clutch being provided with change gears to give a variety of cutting speeds; the speed of reverse remaining constant. It is thus possible to obtain with ease the best results on materials of all kinds from soft cast iron to high carbon steel.

The lubrication of the massive table is a matter of great importance in a machine of this kind, and it is here accomplished by a centrifugal pump forcing oil over the bearings under the table, the arrangement of oil grooves being such as to insure a thorough distribution over the entire surface. Catch troughs are arranged to extend beyond the furthest overhang of the bed and the oil is led back through a strainer to the pump tank.

The housings are of box construction and measure 30 inches wide on the face, and 19½ feet high, and nearly 10 feet deep in the direction of the length of the bed. It is said that the method of driving is peculiarly successful, it being possible to stop and start the table by hand at will and to reverse promptly, so that the table can be used with a very short stroke.

The illustration does not show the vertical slide rests on the uprights, one being obscured by the intervening bed and

table, and the other having been removed for attachment to the auxiliary upright shown at the left. This upright is used in finishing work too wide to pass between the housings and is carried upon the floor plate shown in the illustration, power for feed being derived from the square shaft on the left hand housing for actuating the feed on the auxiliary upright.

* * *

EXPERIENCE WITH A FRENCH TOOL STEEL.

It recently came to our knowledge that a prominent ship and engine building firm of this country had been experimenting with different brands of tool steel and had secured unusually good results with steel furnished by Kron & Company, French Metallurgic Works of Pont-d'Essey, Nancy, France. In fact it was found possible to accomplish with this steel, at a high cutting speed for the class of work, and with almost imperceptible wear of the tool, what could not be done with ordinary self-hardening steels except by frequently renewing the tool. As results of actual experiences with tool steel are both interesting and valuable, we asked for particulars, which are furnished by Mr. William Burlingham, a mechanical engineer connected with the ship and engine building firm and without the knowledge of the makers of the steel. Our informant writes as follows:

"In December of last year, it was necessary to bore a steel strut, the after bearing of the propeller shaft, in a small passenger steamer. The strut was of cast steel and very hard; none of the ordinary tool steels would touch it and recourse was had to the best self-hardening steels in the country. After trying their cutting power at various speeds, 100 inches per minute was determined as giving the maximum cutting effect. The amount of cutting possible was found to be 1 inch axial length with a cut 1-16 inch deep, the tool constantly wearing away until at the end of the inch cut it had to be renewed.

"A tool was then forged from a billet of this French material and put to work. The maximum speed of cutting was increased to 200 inches per minute, with a depth of cut of 1-16 inch, and the strut was bored out its entire length of 35 inches, the taper of the hole at the end due to the wearing away of the tool being but 1-64 inch on the diameter. The difference in the cutting power of the foreign and domestic steels being so marked, correspondence was opened with the manufacturers with the result that a description of the methods of working this steel was forwarded. The translation of these instructions is appended."

GENERAL DIRECTIONS.

Be careful in the forging of steel to use coal as free from sulphur as possible; coke or charcoal is preferable. The heat should not be increased too rapidly, but as slowly and as regularly as possible. The use of bellows easily gives a temporary high temperature to the exterior of the steel, whilst the interior is still cold. If the different parts do not expand evenly, the consequence is, unfortunately, a rupture. The forging, however, should not be completed at too low a temperature. It is recommended during the operation to reheat the steel to a proper temperature. A general rule that it is also well to observe in tempering the steel in forging, is to reheat soft steel to a clear red, medium to a cherry red, and hard to a dark red.

The reheating of the finished tool should be done with the greatest precaution. If a tool unevenly heated is plunged into water to temper, a break is the inevitable result. For that reason one should never use the temperature of the forging to temper it, but it is necessary to evenly reheat the tool anew up to the temperature of the temper. Upon taking the tool from the fire, it should always be held some seconds in the air, in order that the temperature in the interior of the piece be equalized; then plunge in water to temper, shake it around there for some seconds, then let it remain in water of an evenly cold temperature, leaving it in the water until perfectly cold. Only when the cooling process is completed is the operation finished. The water to temper should invariably be at a temperature in the neighborhood of 25 deg. Centigrade.

Directions for Tempering Different Tools.

A. Chisels to Turn and Plane.—The cutting edge should be reheated to temper it, brought again to a clear yellow, after which leave the tool in the tempering water until perfectly cold.

B. Gravers and Chipping Chisels.—For these do not heat further than for the edged tool. Then draw to a bluish red.

C. Taps, Augurs, Drills, Braces, Cold Chisels and Similar Tools.—These should first be tempered slowly, and then be plunged vertically, and not horizontally, in the tempering water, until they are perfectly cold. They should then be put in a bath of heated sand, and returned to it frequently, after which they are evenly heated anew. When the piece has become a dark yellow, cool it again in the tempering water. If the pieces are of small dimensions, tempering in oil is recommended.

D. Punches.—The conical part alone ought to be tempered; and the tool is flattened on the head and sharpened in a manner that makes the point the hardest.

E. Riveting Tools, Picks, Hammers, Etc.—After the tool has been heated to about half its length, place it under a jet of water, in such a manner as to completely fill the eye. Then stand the part not tempered (head) on a red-hot iron until the other extremity (foot) becomes blue. Then plunge it in the tempering water, where it should be left until entirely cooled.

Be careful with each tool to observe at the same time the General and the Special Directions.

Special Treatment of Steel.

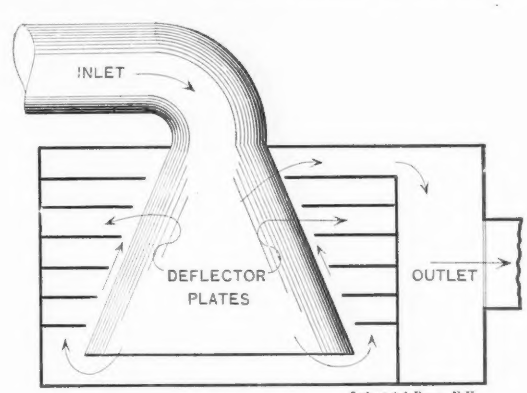
For working very hard articles, it is necessary to reheat the steel as well for forging as for tempering, and with as great care, evenly and not too much. Also the piece should not be forged too cold, and should consequently be reheated to the proper temperature. When the chisel is made, let it cool slowly and completely. Afterward reheat the cutting edge only to temper, and that to a cherry red, and do it steadily. The tempering should be done in water at a temperature in the neighborhood of 30 deg. Centigrade (86 deg. Fahrenheit). The chisel should again be made a clear yellow, and then left in the tempering water until completely cooled.

In connection with the above it will be interesting to state that the new German steel discovered by Herr Sieblen Giebler as mentioned in the January issue, is attracting much attention. It has been thoroughly tested in the Technical High School at Charlottenburg with most astonishing results. A plate of the Giebler steel 3-10 inch thick was fired on and the projectiles (size not stated) penetrated only 1-25 inch. A similar plate of Krupp steel was completely penetrated by the same shots. Sword blades of the new steel are said to shatter the best blades of other steel as though made of wood. Added to these manifest advantages it is claimed that the Giebler steel can be manufactured for fifty per cent of the cost of other steels such as made by the Krupp, Harvey or Boehler processes. Probably fuller information could be obtained by addressing the Technical High School, Charlottenburg, Germany.

* * *

DUST COLLECTOR.

At the works of the Cleveland Twist Drill Co., Cleveland, O., the polishing and grinding wheels are provided with hoods, connected to a suction blower through suitable pipes or ducts, for carrying away the particles of emery, metal and other dust. The connection between the pipe system and the blower is through a large collecting tank made of metal plates and represented in cross-section in the accompanying sketch. This



Industrial Press, N.Y.

tank is very effectual in removing the particles before the current of air reaches the fan. The air enters the tank through the inlet indicated, passing through a diverging mouthpiece which has the effect of decreasing the rate of flow of the current, causing much of the dust to settle. The current then turns sharply upward and most of the particles not already thrown down are here caught by the deflector plates. Finally there is a compartment at the right that acts as a settling chamber for any particles that still remain. The outlet to the fan opens out of this compartment.

FROM THE SKINNER CHUCK CO.'S SHOPS.

The Skinner Chuck Co., New Britain, Conn., recently built an addition to their shop, making it 160 feet long. The old shop was 80 feet long, 40 feet wide and three stories high. The addition is the same width, but four stories high. The construction of the new part is first-class in all particulars. The floor beams are spaced only seven feet apart and the brick pillars between the windows are three feet wide, thus giving nearly four feet window space between the pillars. The floors consist of planking over which are laid two courses of flooring, one diagonally and the other parallel with the sides. The interior walls are all painted white, which, with the extensive windows and comparatively narrow space between the side walls, makes one of the best lighted and most pleasant shops we have ever seen. This condition holds good for all the floors, the basement being equally as well lighted as the upper floors. The latter comes from the building being isolated from other buildings, standing as it does in a large lot by itself.

The business of the Skinner Chuck Co. is exclusively that of making drill, lathe and planer chucks. In fact until quite recently it might be said that drill and lathe chucks were their product, as it is only within a few years that they have made planer chucks and listed them in their catalogues. The addition of the planer chucks was made in response to the many and insistent demands for a good stiff reliable planer chuck to hold work for the cuts now commonly taken in modern planer practice. So it is that the Skinner shop was built and machinery designed and installed entirely for the one business of chuck making, and not unnaturally chuck manufacture may be seen there in a highly developed state.

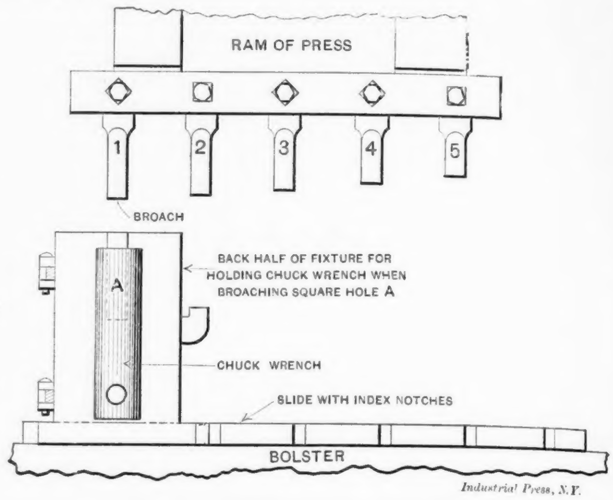
It is not our purpose in the following to give a detailed account of the methods followed in this shop, but only to mention a few of the interesting features observed. The shop methods as a whole represent good shop practice applied to the manufacture of drill, lathe and planer chucks.

The circular racks for combination chucks were formerly made by forging and welding in the time-honored method followed by all blacksmiths. Now, however, all circular racks are electrically welded and the results are most satisfactory to both the chuck makers and users. It is quite rare to have one of the electrically welded racks break apart during the machining operations, and if they hold together during these processes they almost never break in the weld afterward. The teeth of both the circular racks and the pinions on the chuck screws are milled on automatic gear cutting machines.

The screws for the chuck jaws are cut in automatic engine lathes which cut them with a single-point tool in the same manner as a lathesman would do it, but automatically. About all the attention these machines require is to be furnished with lubricant, and to have the work put on the centers and removed when finished; the machine does the rest. The threads of these screws, unlike the screws in other chucks, are cut with the standard U. S. thread section, having an included angle of 60 degrees and flattened tops. The reason for this is that the 60-degree included angle thread is much stronger for the same pitch than a square thread, consequently a finer pitch screw can be used in a chuck, which thus gives greater gripping power with the same length of chuck wrench handle. The disadvantage of increased friction due to the U. S. thread is more than offset by its advantages. It is pointed out that the screws in the Skinner chucks never strip which unfortunately cannot be said of square thread screws.

The chuck jaws are made from drop forgings and are made interchangeable, that is, the jaws for one 12-inch independent chuck will fit in another 12-inch chuck body, all being fitted to standard gages. When the jaws have been machined and fitted, they are casehardened and then ground where necessary to make them again fit the gages. The grinding after casehardening is, of course, necessary because of the slight distortion caused by hardening. The universal and combination chuck jaws are also ground on the faces of the steps after casehardening, so that a piece shall be gripped truly concentric. The faces of the chuck shell or body are also ground to a perfectly true surface.

A recent addition to the line of chucks is independent and combination chucks with flush screws. It appears that while the projecting screw heads are well liked in the United States and preferred in many shops, the factory laws of some foreign countries, notably Germany, prohibit the use of any other but flush head screws on all lathe chucks, hence this new line. The disadvantage of a flush head screw is that a socket chuck wrench cannot be so easily applied, and the double-handle does not afford the leverage that is obtainable with the less cumbersome single-end wrench used on the projecting screw heads.



Rig for Broaching Holes in Chuck Wrenches.

In making the socket wrenches for the flush head screws the square hole for the screw is broached. The body of the wrench is drilled quite deeply for the screw head, and then the square is broached out in five successive operations under a sub-press. The five broaches are all attached to the ram of the press and all move together. Beginning at the left, they increase in size but decrease in length. The wrench body is held in a vertical jig which opens longitudinally, and which has a square hole in the top for the entrance of the broaches. The first broach cuts out the corners to a depth considerably further than that required by the screw head. The second broach cuts out still more, but does not descend quite so far. The third enlarges the square and stops still further up, and so on until the fifth and finishing broach which stops at a depth slightly more than sufficient for the screw head. In this manner the square is broached out with no trouble whatever with the chips, as these are crowded into the drill hole and left there. The jig for holding the work is indexed along successively under the broaches for each stroke, and notches are provided for a latch which holds it solidly in place during each stroke of the ram.

The bodies of drill chucks are turned from bar steel in a Hartford automatic screw machine. The three slots for the jaws are milled in ordinary milling machines while the chuck bodies are held in a Brown & Sharpe fixture. The jig or fixture holds them at the proper angle and is provided with a three-hole index for the three slots. The hole is not drilled clear through the center of the chuck body, but can be if the user desires to hold long rods. Otherwise it is better to leave the division wall intact as it supports the end of the drill and prevents its slipping upward into the chuck body when under heavy pressure. The jaws are casehardened and ground while held on a magnetic grinding chuck.

The fourth floor of the new part of the shop is used for a stock room in which chucks are kept boxed ready for shipment. The boxes are plainly stenciled with the size and the style of chuck contained, so that the filling of a hurried order is the work of only a few minutes before it can be on its way to the railway station.

The blacksmith shop is in the boiler room, and the engineer is also the blacksmith, a happy combination which makes him a most useful employe. The casehardening furnace is also in the boiler room, and is attended by the engineer-blacksmith. The hot gases from the casehardening furnace are piped into the boiler setting back of the bridge wall, so that when in use it helps materially in keeping up steam and saves burning so much coal in the boiler furnace.

LETTERS UPON PRACTICAL SUBJECTS.

POWER FEED ATTACHMENT FOR A HAND SCREW MACHINE.

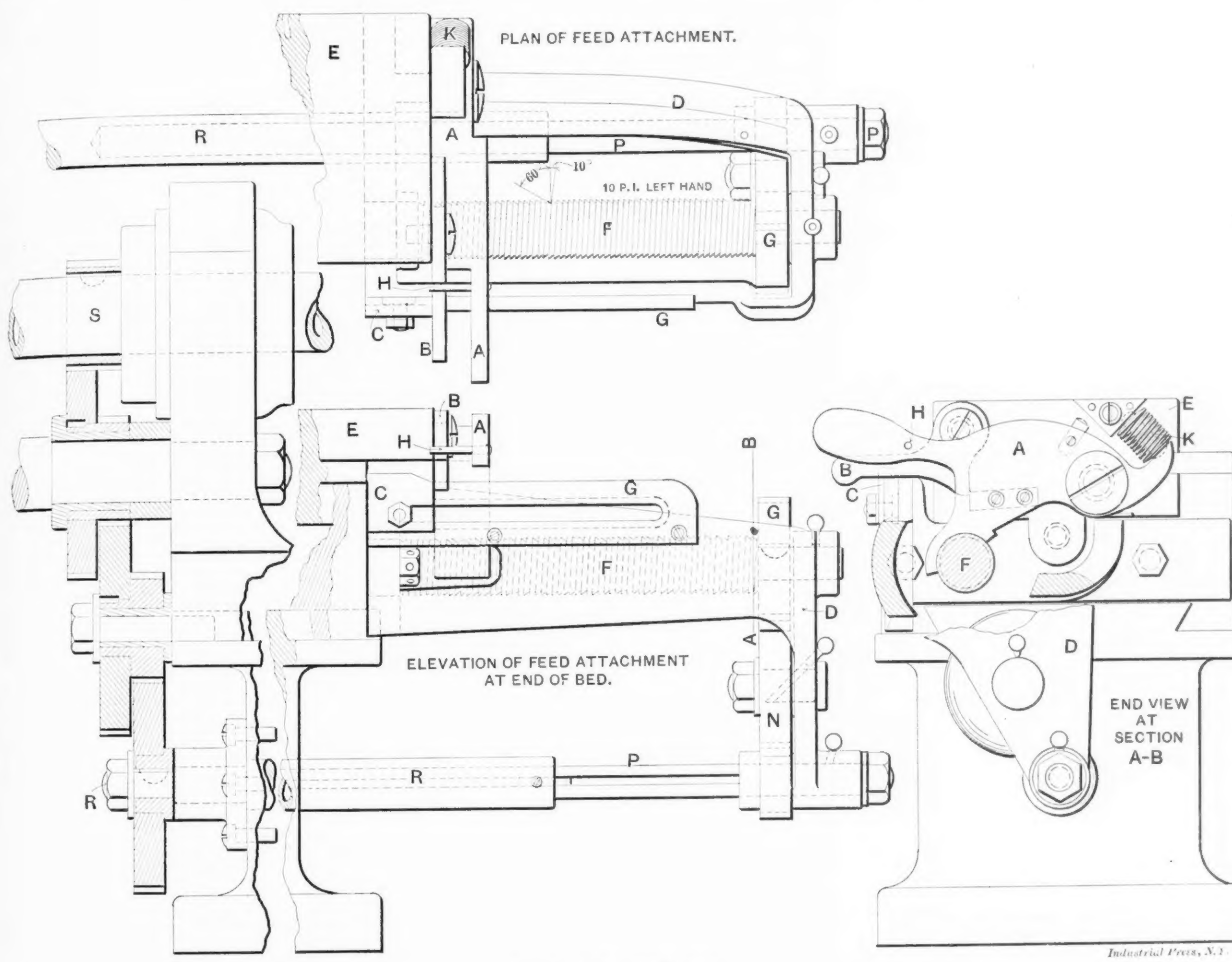
Editor MACHINERY:

The accompanying sketch shows diagrammatically a power feed attachment with an automatic stop, which was applied to a No. 2 Pratt & Whitney plain hand screw machine, and which has been in satisfactory use for nearly ten years. It has proven to be very efficient in taking long cuts which require to be very accurate and uniform, although it works very well when taking as heavy a cut as the belts will drive.

As may be seen in the plan and elevation views, power for the feed screw, *F*, is transmitted from the spindle, *S*, through a train of gears to a shaft, *R*, under the bed which communicates its motion through its telescopic extension, *P*, and another train of gears at *N* up to the feed screw pinion, *G*. The shaft, *R*, permits of *P* being telescoped within it for a sufficient distance to allow the foot block which supports the feed screw to be moved to any desired position along the bed. The outer end of the smaller shaft, *P*, is supported by an overhanging frame casting, *D*, which is bolted to the foot block. The feed screw, *F*, has a left hand ratchet, or bastard, thread.

To the end of the turret slide, *E*, is fastened a lever, *A*, which contains a section of a nut so placed that it may be thrown into engagement with the feed screw, *F*, to move the slide forward in feeding. For throwing off this power feed when the desired length of cut has been taken there is a latch, *B*, pivoted on the slide behind the lever, *A*, and arranged so as to rise up and pry the lever, *A*, out of engagement with the feed screw when it strikes the inclined edge of the knock-off block, *C*. The knock-off block is capable of adjustment along the grooved guide, *G*, for throwing out the feed at various points. The latch, *B*, pries the lever, *A*, off the screw by means of the pin, *H*, after which the spring, *K*, throws the lever up and holds it clear of the screw. The spring, *K*, was made by chucking a hole in a piece of round steel and then cutting a square thread on the outer surface and going down deep enough to cut entirely through to the arbor, which made a very stiff spring of square section.

One piece of work made from a drop forging that is now done in this machine, used to be centered and roughed out in a lathe and then finished between dead centers on a universal grinder; while now it is done in one operation in this machine by simply using one extra box-tool cut. This job has no limit allowed, but comes out from the machine to a ring gage fit with careful operation. The power feed attachment was designed by Wm. A. Murray of the S. S. White Dental Mfg. Co., Staten Island, N. Y. S. J. P.



Details of Screw Machine.

REMEDY FOR A HOT CRANKPIN BOX.

Editor MACHINERY:

Having frequently read of methods for remedying hot crankpin boxes, I would suggest a method of tinning which I have used very successfully.

First take down the brasses and thoroughly clean these and the crankpin of all oil. With a scraper or sandpaper (do not use emery cloth) scrape the inside of the boxes so as to show new brass at every point, then spread nitric acid over the whole bearing surface. Now replace the brasses, leaving about 1-16 inch clearance all around, the connecting rod being jacked up so as to hold the crankpin central in the box. With putty stop up the opening between the brasses, on the bottom; also fill the oil hole in the strap and punch a hole through it with a stick. This will prevent the tin from getting into the threads of the oil hole. Through this hole pour melted tin into the bearing, bar tin being used for this purpose. It is well to have the brasses warm before pouring the tin. Now take the boxes down, clean out the oil hole and make an oil groove along the top of the bearing. Do

not file for clearance or make any attempt at fitting; simply oil thoroughly and replace them.

The box may run warm and pound a little at first, but after a few hours will run all right. This is due to the fact that the tin, being soft, readily adjusts itself to the irregularities of the crankpin. J. C. ROLEAU.

Procter Knott, Minn.

* * *

COLLAPSIBLE DIE FOR THREAD CUTTING.

Editor MACHINERY:

This collapsible die head is for use on short threads usually found on plumbers' goods and has a few features that commend it to all mechanics who appreciate the value of producing good threads in a rapid manner on castings of large or small diameters.

The principal feature of this die is the threading of work without backing off; another feature is that it is possible the grooves, allowing the operator to remove the die from the work without reversing and backing off.

The turning tools are made about 1-16 inch longer than the threaders, as shown at *A* and *B*, Fig. 2, in order to remove the stock necessary to reduce the piece to be threaded to the required diameter. The turning tools are also prevented from pressing against the inside of the ring by mortising the slots about ¼ inch in and away from the diameter for the body *E*. The casing *G*, Fig. 2, containing the coil springs, also acts as a stop for the bottom part of the threader, striking against the casing at *J*, Fig. 1.

This style of die head is of great service where a quantity of pieces are to be threaded. Different diameters may be accommodated by making extra sets of threaders and turners, Figs. 3 and 4 show the side elevation of these turners and threaders. GEORGE J. WINKLE.

Brooklyn, N. Y.

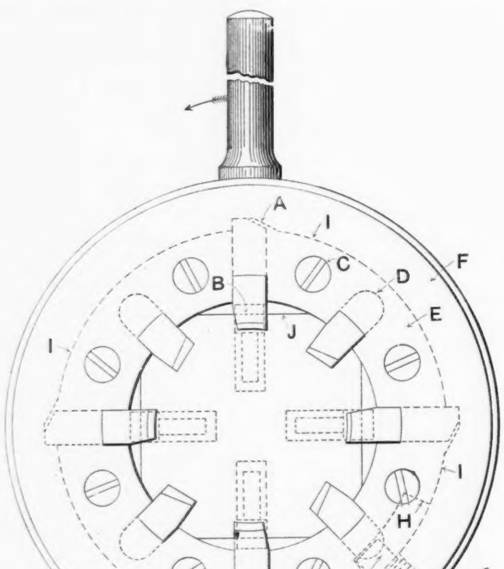


Fig. 1.

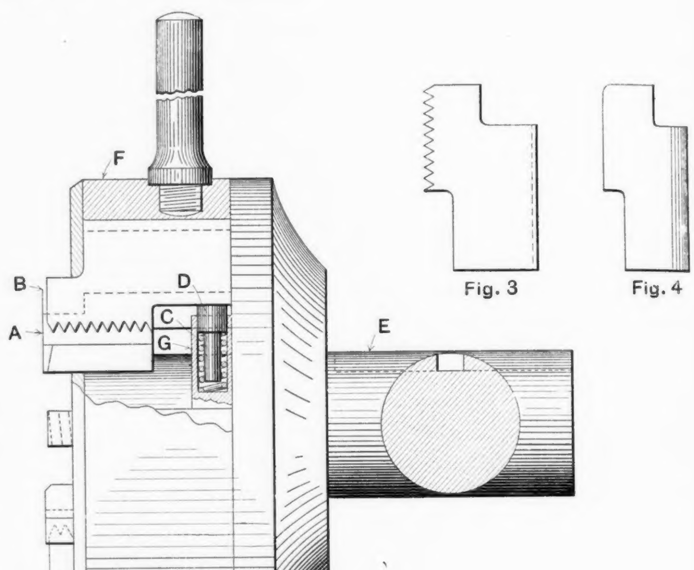


Fig. 2

Fig. 3

Fig. 4

with the turning tools contained in the same head to turn down the stock and thread it in one operation, doing away with the common practice of turning and threading with separate tools, which makes two operations necessary. Where practicable it is best to use a leadscrew on the turret lathe or drill press (on either of which machines the die can be used) that can be geared the same as an engine lathe. This method, while not necessary, will produce better results, as a die is doing its full duty when it cuts the thread, and therefore any extra load placed upon it, such as drawing the turret, tends to the cutting of a more or less distorted thread.

The construction is very strong and simple. Referring to Fig. 1, *E* is the body part, cast solid with the shank *E*, Fig. 2. the body is slotted for the reception of the threaders *B* and turning tools *D*, Fig. 1. The outside ring *F* is fitted to the body *E* and contains four grooves *A* running the entire width of the ring and spaced equidistant to correspond with the threaders. When the die is at rest the threaders are forced back into the grooves by the plunger *D*, Fig. 2, actuated by the coil spring *C*, and when in this position the diameter of the die is increased to the amount of the double depth of the grooves. Said depth is regulated by the pitch of thread being cut; if the thread has a depth of, say, ⅛ inch it is advisable to make the grooves about 5-32 inch.

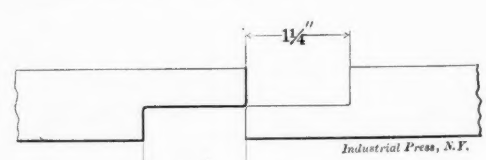
By throwing the lever in the direction indicated in Fig. 1 by the arrow, until the end of the screw *G* comes in contact with the opposite end of the slot *H*—which forms a positive stop for the movement of the ring—the backs of the threaders will rest against the bore of the ring at *I*, and when in this position the die is ready for work. After the die has cut the length of thread required, the movement of the lever is reversed, the grooves are brought in position behind the threaders, and the springs force them back into

FINISHING CAST-IRON RINGS.

Editor MACHINERY:

I was much interested in the article in January MACHINERY on a method of finishing cast-iron rings, by "A. J. D." I cannot help questioning the accuracy of his method, however, as I have finished a great many piston rings and have never been able to finish a ring properly until after it has been split.

My method is as follows: We will assume, for example, a ring 12 inches outside diameter, 5-16 inch thick and ¾ inch wide. First face up one side of the casting, turn to 12 9-16 inches outside diameter, bore to 11½ inches diameter, and cut off to the required width—¾ inch. The ring is now split, as shown in the sketch.



This is the same method as was used by "A. J. D." and is, if properly done, the best method I know for splitting rings. Now, with a wire, draw the ring together until the joint is closed tight. Clamp the ring on a faceplate with five or six clamps placed on the inside and, removing the wire, turn the outside diameter to 12 inches. Then, one at a time, remove the clamps and transfer them to the outside, after which the ring is bored to 11⅜ inches inside diameter. This gives a ring that is 5-16 inch thick.

I never make rings eccentric, because, as they are split

before being finished, they have all the "backbone" necessary. When this ring is put in the cylinder the joint is tight and the ring is true.
A SUBSCRIBER.

* * *

A CAST-IRON PUNCH AND DIE.

Editor MACHINERY:

A friend of mine recently designed some "former" dies to be used on a "bulldozer" for making car coupler spring pockets, the idea being to form the pieces and punch the rivet holes simultaneously, thus completing the pieces at one heat from a straight bar of proper length.

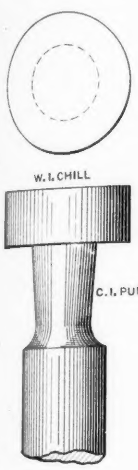


Fig. 1.

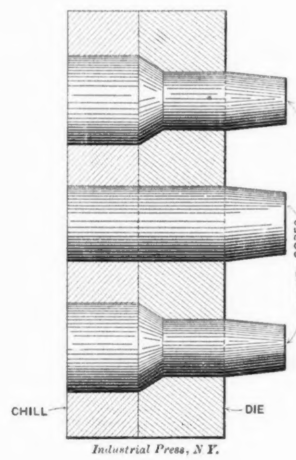


Fig. 2.

For making the holes cast-iron dies and punches were used. The dies were chilled on their faces and the punches on the ends. Fig. 1 shows the chill used for the punch and Fig. 2 the arrangement of chill and cores for the die. The two countersunk holes in the die were for fastening bolts.

At first it was intended to simply grind the end of the punch and the face of the die, but although the chills were of wrought iron, machined smooth, with holes drilled to receive one end of the cores, yet the faces of the dies were rough and the edges of the holes had anything but sharp corners. For this reason the cores were made smaller and the holes were ground out to size. With this change the cast-iron punches and dies worked very satisfactorily both on this and similar jobs. The only trouble has been that the chilled parts are not always uniform, occasionally having soft spots, but I think the cause of this is that the quality of cast-iron used may not be the best for chilling purposes.

For work like this the cast-iron punch and die seems admirably adapted, as the first cost is considerably less than it would be for forged steel and the resistance to crushing is quite sufficient to punch 1-inch holes in red-hot iron 1-inch thick.
WM. NEWTON.

Oneonta, N. Y.

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A USEFUL TABLE IN THE MACHINE SHOP.

Editor MACHINERY:

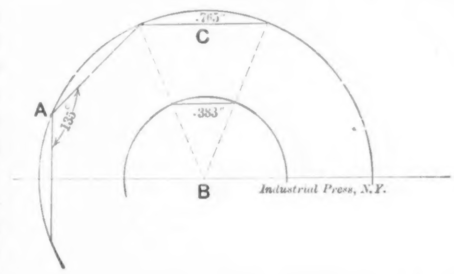
I send a table giving the regular polygons, the number of sides, angle at center, exterior angle, and the length of side of chord to a radius of ½ inch. I think it may be of interest to your readers and, as far as I know, it is original. In this table the chords are given to the nearest thousandths. In the machine shop it is frequently necessary to make some of the polygons on the planer, shaper or milling machine; and, to find the length of a side, it is usually laid off with the

NAME	Sides.	Length of Chord for a Rad. of ½ inch.	Angle at Center.	Exterior Angle.
Square.....	4	.707 in.	90°	90°
Pentagon...	5	.588 "	72°	108°
Hexagon...	6	.500 "	60°	120°
Heptagon..	7	.4338 or .434 in.	51° 25′ 42″	128° 34′ 17″
Octagon....	8	.383 in.	45°	135°
Decagon....	10	.309 "	36°	144°
Dodecagon..	12	.258 "	30°	150°

The chords are given to the nearest thousandths.

dividers. This is a slow method, and the use of this table renders it unnecessary.

The way to use it needs little explanation. Suppose we are going to cut an octagon out of a piece having a radius of 2 inches. Referring to the table we find the chord or side of an octagon of ½ inch radius to be .3826 inch; then, as all chords of a given angle are in direct proportion to the radius of the intercepted arc, the length of a side would be 4 x .3826 = 1.5304 inches. And glancing along the same line, we find the exterior angle of an octagon to be 135 degrees. Set the piece to be cut in the chuck and cut the side 1.5304 inches. Then with the protractor set to an angle of 135 degrees, turn the piece so that the planed side will coincide with it, and repeat until the eight sides are cut.



In the accompanying cut, *A* is an exterior angle, and is found by using the geometrical rule: The sum of the exterior angles of any polygon equals two right angles, times the number of sides less two. Example: To find the exterior angle of an octagon. Since there are eight sides, we have 2 (8 — 2) = 12 right angles; and one exterior angle is equal to 12 ÷ 8 = 1½ right angles = 135 degrees.

B is the angle at the center and is found by dividing 360 degrees by the number of sides, or 360 ÷ 8 = 45 degrees

Beaver Falls, Pa.
JOHN GILLEN.

* * *

OIL ANTI-SPLASH DEVICE.

Editor MACHINERY:

Our bolt cutter gave a great deal of trouble by spattering oil on the machine and its operator, and an investigation showed that the trouble was caused by air being mixed with the oil. In order that the reservoir tank might be removed for cleaning, the supply pipe had been provided with a loose joint and the supply of oil sometimes ran low enough to allow air to be sucked in during part of the stroke. The

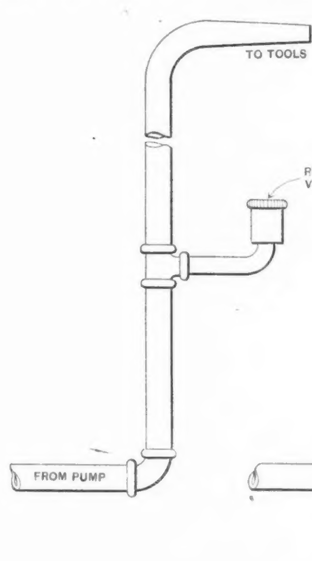


Fig. 1.

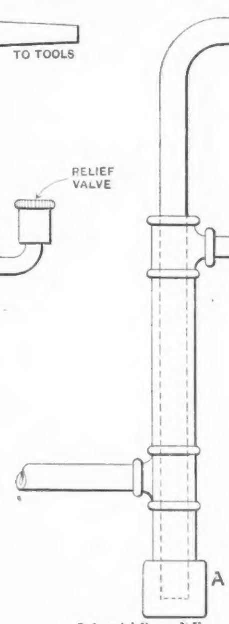


Fig. 2.

discharge was piped as shown in Fig. 1, the surplus oil escaping through the relief valve and returning to the tank. To remedy the trouble I made the alterations shown in Fig. 2. On the pipe from the pump I put a *T* which was a size larger on the run than the pump pipe. From one end of this *T* a nipple and a cap formed a small oil pocket *A*. From the other end of the *T* a pipe ran to a second *T* having a side branch to the relief valve; while the end was bushed, allowing the

pipe leading to the tools to pass down inside of the larger pipe to the pocket A.

Now all the air passes off with the surplus oil through the relief valve, the oil is free from air and the spattering is thus prevented. W. A. BRIGHT.

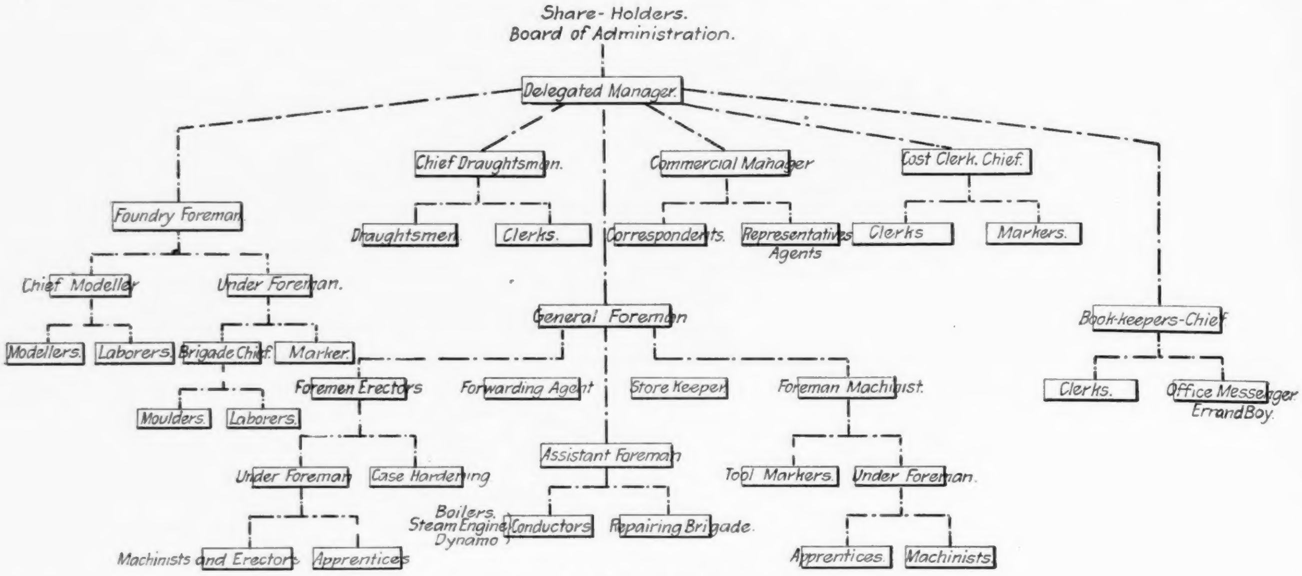
Decatur, Ill.

* * *

ANOTHER SHOP TREE.

Editor MACHINERY:

I read with interest in your November number the paragraph entitled a "Shop Family Tree," which was accompanied by a diagram showing shop organization of the Bickford Drill and Tool Co., Cincinnati, O., and indicating to whom each employee should look for his authority.



A Belgian "Shop Tree."

I should be glad to see other shops publish diagrams of their organization, and I inclose that for our works (Ateliers de Construction, H. Bollinckx, Bruxelles), with the names translated into English. Ours is a "Société Anonyme;" that is to say, it is represented as capital by a certain number of parts called "actions." It is managed by a certain number of delegates (in our works five) called "administrateurs," who meet at least four times in a year and more if there are important questions to be discussed.

One of these "administrateurs" is delegated by the others, and is called "administrateur délégué." He is charged with the general managing, and must sign all documents, with the bookkeeper usually. ARTHUR BOLLINCKX.

Bruxelles.

CENTERING WORK ON THE FACEPLATE.

Editor MACHINERY:

In doing faceplate work it is always desirable to clamp the work as near to its correct position as possible before putting the faceplate in the lathe. I send sketches of a device which I have found very convenient for locating work on the faceplate approximately correct before making the final adjustment with the center indicator.

Fig. 1 shows the application of a common surface gage to centering work in the faceplate. The pins a a project from the bottom of the gage base and are held against the outside edge of the plate. The point of the bent end of the scriber is set to the center of the faceplate. As it is usually difficult to set the scriber point to the center of the plate without some locating point, a bushing b is fitted to the hole in the center of the plate. This bushing has a hole in its center through which the rod c may be slid up or down to its desired position. The scriber is set to the point of this rod, thus immediately locating the center of the faceplate. By setting work in this way the trouble incident to changing the clamps after the work is swung in the lathe is thus avoided.

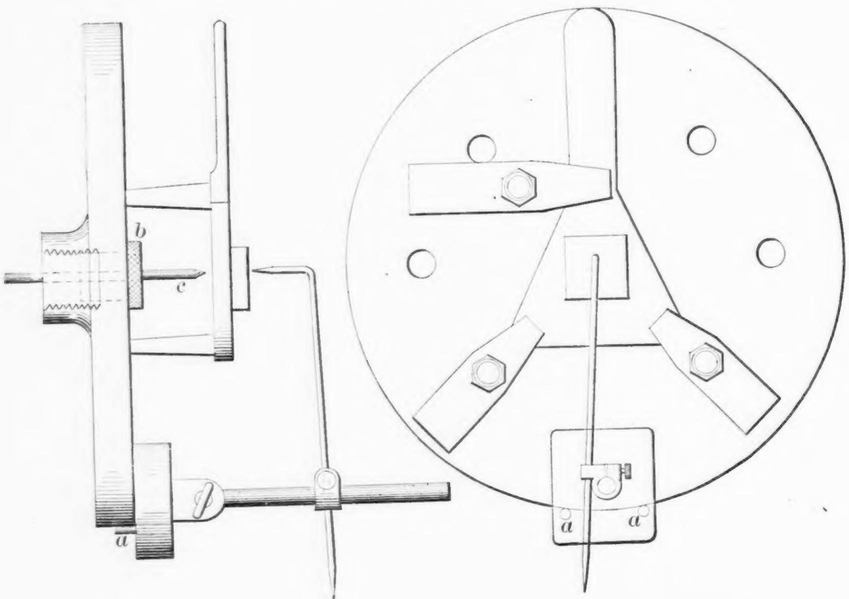


Fig 1.

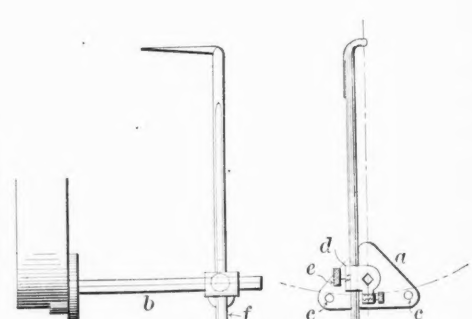


Fig. 2.

There are a number of different surface gages in the market, having pins which may be made to project below the base, that may be used in this manner, and when any of these are employed the bushing and pin b and c will be found of great assistance.

Fig. 2 is a sketch of a permanent tool for centering work in

the faceplate. It consists of a base *a*, in which is a square post *b*, while the pins *c c* project below the surface of the base. A clamp *d* carries the scriber, which may be set at any height on the post. The scriber is flattened on one side and held in position by the setscrew *e*, which bears against the flattened side. The point of the scriber is offset in order to bring it over the center of the plate. A series of marks *f f* enable the scriber to be set at once for different sizes of faceplates. JAMES P. HAYES.

Meriden, Conn.

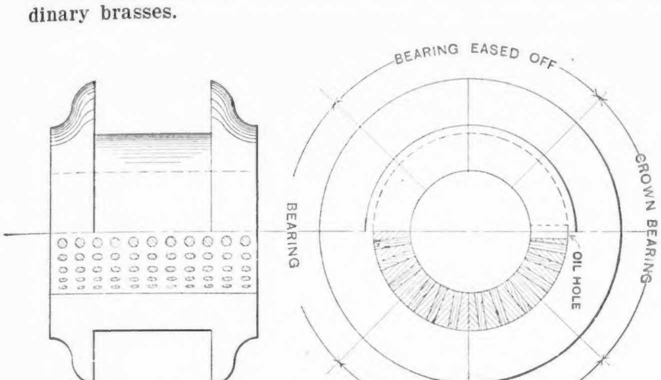
* * *

A BEARING FOR HIGH SPEEDS.

Editor MACHINERY:

The accompanying sketch shows a bearing that I have found very efficient for shafts running at extremely high rates of speed. The size and shape of the bearing can, of course, be made to suit the case at hand. The best composition for the casting is: Tin, 13.00 parts; copper, 112.00 parts; zinc, .25 part.

The first thing to be done to the castings is to drill the bearing full of small holes, 3-16-inch or so in diameter, and as deep as the thickness of the casting will permit. Then into all of these holes drive hardwood plugs. After this the halves may be soldered together and bored and turned the same as ordinary brasses.



Anti-friction Bearing.

Care should be taken to have a good crown bearing, the sides being eased off with a scraper, as shown in the sketch.

This bearing is especially suitable for emery and polishing wheels, as speeds of 30,000 to 40,000 revolutions per minute may be obtained without much heating, if the bearing is carefully made of the composition mentioned. W. C. HENSLEY.

New Haven, Conn.

* * *

A PNEUMATIC BELT SHIFTER.

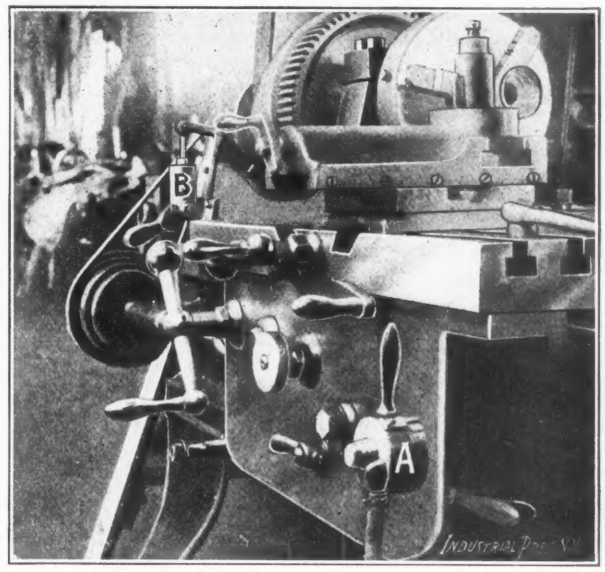
Editor MACHINERY:

In doing a large class of lathe work much time is used up in starting, stopping and reversing the machine. On brass work especially, such as machining valves, cocks and nuts, where it is necessary to reverse for thread cutting, the lathe is run at a high speed, without back gears, and the time spent in operating an ordinary countershaft may be conservatively estimated as 20 per cent. of the entire time spent on the work.

It was for saving time on this class of work that the pneumatic belt shifter and brake was devised. With this appliance the belts are shifted and the brake is applied by the movement of the hand lever of a pneumatic valve, placed on the lathe apron where its nearness to the other levers of the apron makes it convenient of operation. This valve is shown at *A*. In it there are five parts, any one of which may be utilized by moving the lever so that the valve covers the desired port. The valve itself is connected, by a flexible tube, to the general air supply pipe of the shop.

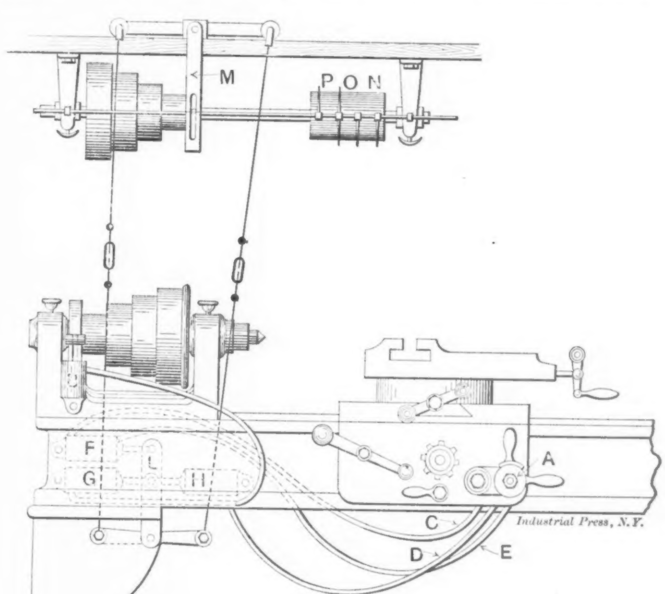
The central position of the lever is the "stop" position; when the lever is placed here the driving belts are thrown out of action and a brake is applied to the lathe spindle. The port on the left of this is the "forward" port while the one to the right is the "back" port. The two outer ports are release ports for the cylinder of the pneumatic brake. When running forward if it is desired to run back the lever is thrown directly from left to right, passing over the central port.

The pneumatic connections will be seen by reference to the illustration. From the valve *A* run three pipes, *C*, *D* and *E*, to the air chambers. *C* and *E* connect the "forward" and "back" ports of the valve with the two ends of the reversing cylinder *F*. Pipe *D* connects the "stop" port of the valve with the two stopping cylinders *G* and *H*, while a branch from *D* runs to the brake cylinder *B*.



View of Lathe with Pneumatic Attachment.

The mechanical part of the device requires but little description. The two arms of the reversing lever *L* are connected by two wire rods to the two corresponding arms of the belt shifting lever *M*. If the valve lever is placed so as to cover the "forward" port, air will be admitted through pipe *C*, to the back end of the cylinder *F*, the reversing lever will be thrown to the right, carrying with it the belt-shifting lever and thereby throwing the open belt from the loose pulley *N* onto the driving pulley *O*, thus driving the lathe forward. Placing the valve lever over the "back" port of the valve causes



Details of Pneumatic Connections.

the belt shifter to be thrown in the opposite direction; thereby throwing the crossed belt from its loose pulley *P* on to the driving pulley *O*, thus reversing the direction of the lathe.

When the valve lever is placed in a central position air is admitted through the pipe *D* to the two cylinders *G* and *H* thereby putting the levers in a central position, as shown, both driving belts being held on their respective loose pulleys *P* and *N*. At the same time air passes, through the branch

from pipe D, to the brake cylinder B and the brake is applied to the lathe spindle, thus immediately stopping the lathe.

ALFRED MUNCH.

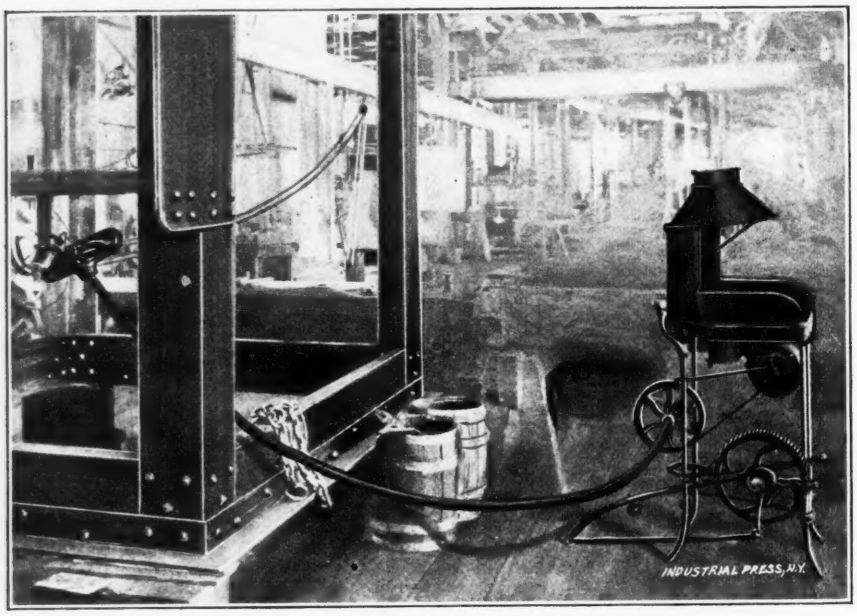
St. Paul, Minn.

* * *

A NEW USE FOR A FLEXIBLE SHAFT.

Editor MACHINERY:

In riveting up a lot of structural steel scales at the Fairbanks Machine Shop a small portable forge was used for heating the rivets. This was worked by a hand lever and re-



Blower Driven by Flexible Shaft.

quired the entire attention of one man or boy. Power was plenty all around, but was not available since the forge had frequently to be moved. Compressed air or an electric motor might, of course, have been used had either been at hand, which was not the case. In this extremity a Stow flexible shaft that had been used about the drilling was called into use to run the blower. A clutch was easily made and fitted to the arbor of the forge, to which the flexible shaft was attached as in the accompanying photograph, the shaft being run by a rope drive which may be seen leading away in the distance. With this arrangement the forge could be kept within easy reach of the riveters and much time was saved. "If the mountain won't come to Mahomet, then Mahomet will go to the mountain."

W. H. SARGENT.

A COMBINATION DRILLING AND TAPPING FIXTURE.

Editor MACHINERY:

In Figs. 1 and 2 are views of a fixture which was designed and constructed by the writer for the rapid drilling and tapping of certain work in which a low cost of production was the chief consideration. It is built for use on a two-spindle drill press, the drill being operated in one spindle and a tapping attachment in the other. The work to be drilled is located and fastened on the fixture, as shown at E. It consists of a circular finished casting turned all over and has a reamed hole through the center which has a keyway let down through it, the keyway having been located and finished in an interchangeable position in all the castings by means of a fixture on the slotter.

The body of the fixture is in the shape of an angle plate, and is finished dovetail for the entire length of the face at B B, to admit the slide plate C. The index plate D is of cast iron, with one end turned to fit and revolve in the slide plate C, the nut P and washer O keeping it in position. The projection on the other end of the plate is turned to fit the hole in the work and a key let in at F. The work E is fastened against the index plate D by the nut and washer at G. There are six equally spaced holes in the index plate D, as shown at H, and the index pin I is entered through these holes in the plate and into the slide C, as shown in Fig. 1. For locating the slide C central with the drill bushing N, the knurled pin K is used, entering through the slide and into a hole in the main casting. The hole L shown in the plan view, Fig. 1, is for locating the plate under the tap, so that the holes drilled in the work will come central with the tap.

To operate the fixture it is first located on the drill press plate in an upright position, as shown in Figs. 1 and 2, with the bracket M at the top, so that the bushing N comes central with the drill spindle, and then fastened down in that position by two cap screws through the base. The work is then fastened on the index plate, as described, and the pin K entered

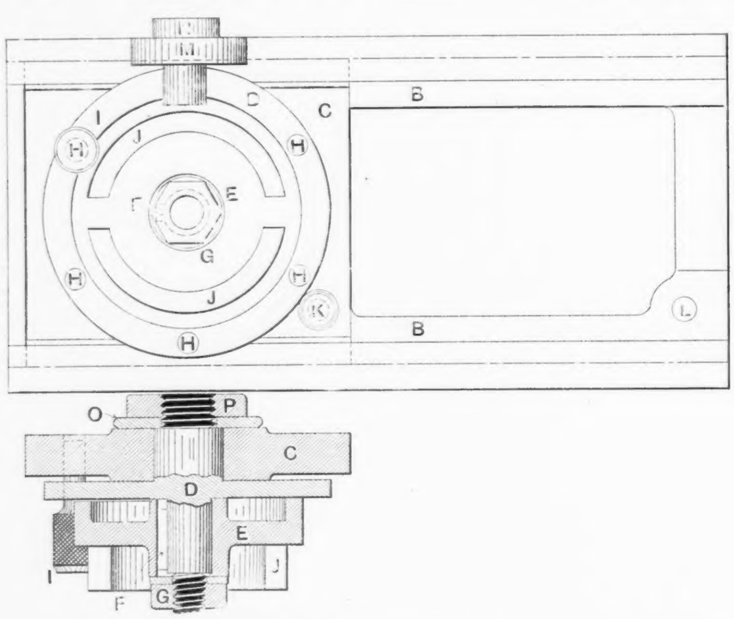


Fig. 1. Side and Sectional Views of Fixture.

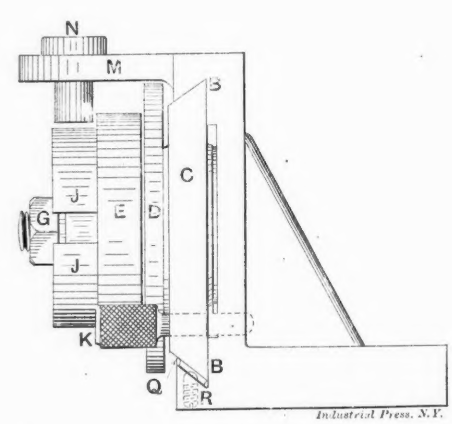


Fig. 2. End View of Fixture.

into the hole in the body casting, thereby aligning the work with the drill bushing. Index pin I is then entered into one of the holes H and the first hole drilled, the latter operation being repeated until six holes have been drilled, three in each of the segments J J. The slide plate C is then moved over to the opposite end of the fixture and centered under the tap by the locating pin K entered into the hole L, after which

the drilled holes are tapped. There is a large variety of work that this kind of fixture can be adapted for, for performing drilling and tapping in one jig.

JOSEPH V. WOODWORTH.

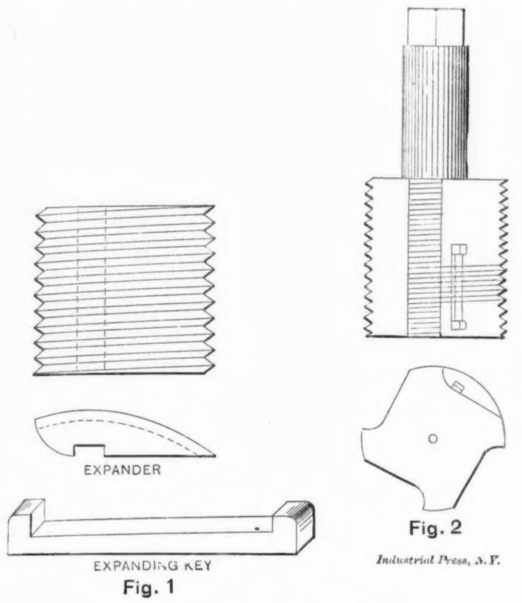
* * *

A TAP EXPANDER.

Editor MACHINERY:

When a tight-fitting thread is encountered it is often easier to tap the hole large to fit the thread, than to cut the thread to fit the tapped hole. For this purpose the tap expander here shown has been used very satisfactorily.

Fig. 1 shows a detail of the expander and expanding key, Fig. 2 shows the expander in position in the tap. The expander is threaded to correspond to the tap with which it is



A "Tap Expander."

to be used and is shaped to fit one of the flutes. When a hole is to be re-tapped the tap is first started into the hole and the expander which is tapering, run loosely with the tap for a few threads. The taper key is then forced down, thus setting out the expander and the tap is run through the hole as in ordinary tapping. The threads will, of course, be cut deeper an amount depending upon the extent to which the expander was set out.

R. P.

Auburn, N. Y.

* * *

A TURRET TOOL FIXTURE.

Editor MACHINERY:

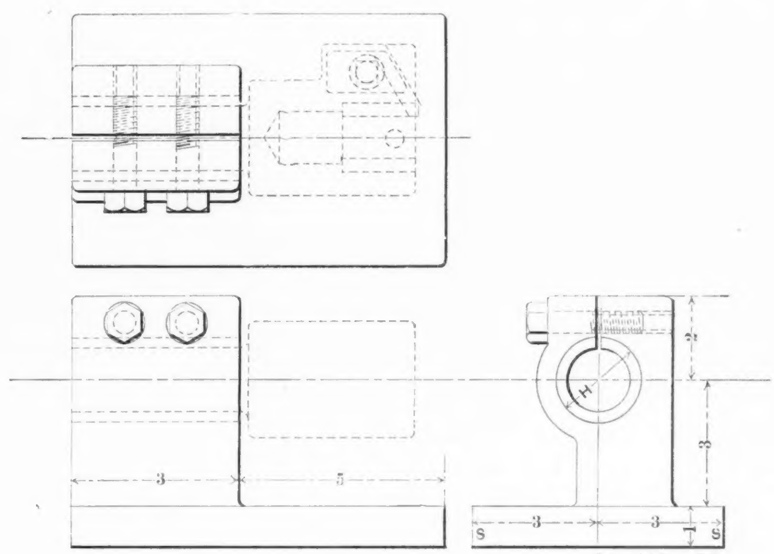
The accompanying sketch illustrates a handy fixture designed to facilitate the milling, drilling and laying out of turret tools. The sketch explains the construction plainly, but there are a few points regarding it which make it especially convenient and valuable.

The first object in the design of this tool was to make it so that it would hold the work rigidly, clamp it quickly, and require no blocking or supports to prevent tipping while machining.

Another object was to afford a ready means of accurately locating points on the surface, depths of slots, planed or milled, or holes to be drilled. The fixture consists of a casting, shown in the sketch, fitted with two binding screws for clamping the shanks of the turret tools. The hole *H* is provided with bushings of various sizes to take different sized shanks. The base extends forward from the upright sufficiently to prevent tipping when work is being done at the front end of long box tools. The upright column is made heavier on one side than on the other so that the weaker side will always clamp up rigidly against the tool.

As many box tools are left rough all over, except at the working points, it is usually awkward to locate points accurately. By making surfaces on the fixture to even dimensions, measurements can be made easily. Thus, bottom to center of hole 4 inches; thickness of base 1 inch; sides *S* and *S* both 3 inches from center; top 2 inches from center. It will be seen at once that by the use of gage blocks, tools can be readily set and points easily located. If the fixture is to be used often on the milling machine, a line can be put on the column to show when the center of the hole is in line with the center of the spindle when the fixture is clamped to the table. Where many tools are made, a tool of this kind will undoubtedly repay its cost in a short time.

W. R. G.



Fixture for Machining Turret Tools.

* * *

UNUSUAL EXAMPLE OF KNURLING.

Some remarkable specimens of knurling were recently seen in the shops of the Hoggson & Pettis Mfg. Co., New Haven, Conn. This firm is generally known as the manufacturers of the Sweetland chuck, but they also build special machinery and dies, the latter especially for rubber factories. The knurling referred to was on a roll for producing the corrugations on rubber boot soles. The "diamonds" were probably ⅛ wide by 3-16 inch long, deeply cut, and were made with an ordinary knurling tool having one roller. It was elicited that the only precaution taken to get regular and accurate knurling with this tool was to be sure that the pitch circumference of the rubber roller is such that it will be evenly divisible by that of the knurl. Otherwise, of course, the corrugations of the knurling tool would not exactly register with those produced in the roll during the first revolution, but instead would crush down those already made. The work was an interesting example of what it is possible to do with pressure and rolling contact tools, and the suggestion is made that perhaps such processes are not as much used as they might profitably be in many machining operations now done by cutting tools.

* * *

BORING LONG CYLINDERS.

Chas. V. Imeson, Pueblo, Col., writes: Referring to query No. 8 of W. H. H. in October MACHINERY, I once had an experience similar to his. I was boring some cylinders some 5 or 6 feet long for 8 or 9 inches bore; I had a bar with three tools, and used a star feed. The first cylinder was not true; it was either larger or smaller in the center than at the ends. I procured a piece of cast iron about 5 inches thick by 10 inches in diameter and turned it to the size of the bore of the cylinder. Next I bored it to fit the bar, and bolted it securely to the head and allowed about ½ or ¾ inch between the tools and the edge of the casting, which would turn in the cylinder with the bar. With this device I found that in all cases the holes were perfectly true. One can readily see that the casting being turned so that it will work in the bore of the cylinder, and having as little friction as possible and following the tools, will hold the tools steadily in their place, thereby insuring an almost, if not perfectly true hole. If W. H. H. will try this I think he will have entire satisfaction.

DESTRUCTION BY FIRE OF THE FAMOUS WHITELY SHOPS AT SPRINGFIELD, O.

On February 10th, fire broke out in the immense East St. shops at Springfield, O., and nearly the entire structure was reduced to ruins. These shops were erected in 1882 by William N. Whitely, the "reaper king," at a cost of from $750,000 to $1,000,000. These shops covered 44 acres of ground, and when first erected were the largest shops in the world, while at the time of the fire they were said to have been the second largest factory buildings under cover. Their original machinery equipment was estimated to have been worth $2,000,000. The Whitely Harvester Co., which occupied the plant, failed after a few years and the buildings stood idle until 1894, when Senator Fairbanks of Indiana purchased them and they have since been gradually filling up until at the time of the disaster they were almost entirely occupied. Fourteen firms had quarters there, among them the Owen Machine Tool Co., the Grant Axle & Wheel Co., the Miller Gas Engine Co., the Progress Stove & Furnace Co., the Springfield Foundry Co., and the Fairbanks Machine Tool Co. With the exception of the Indianapolis Frog & Switch Co., the Shouvlin Gas Engine Co. and the Fairbanks Machine Tool Co., the loss to these fourteen firms was complete.

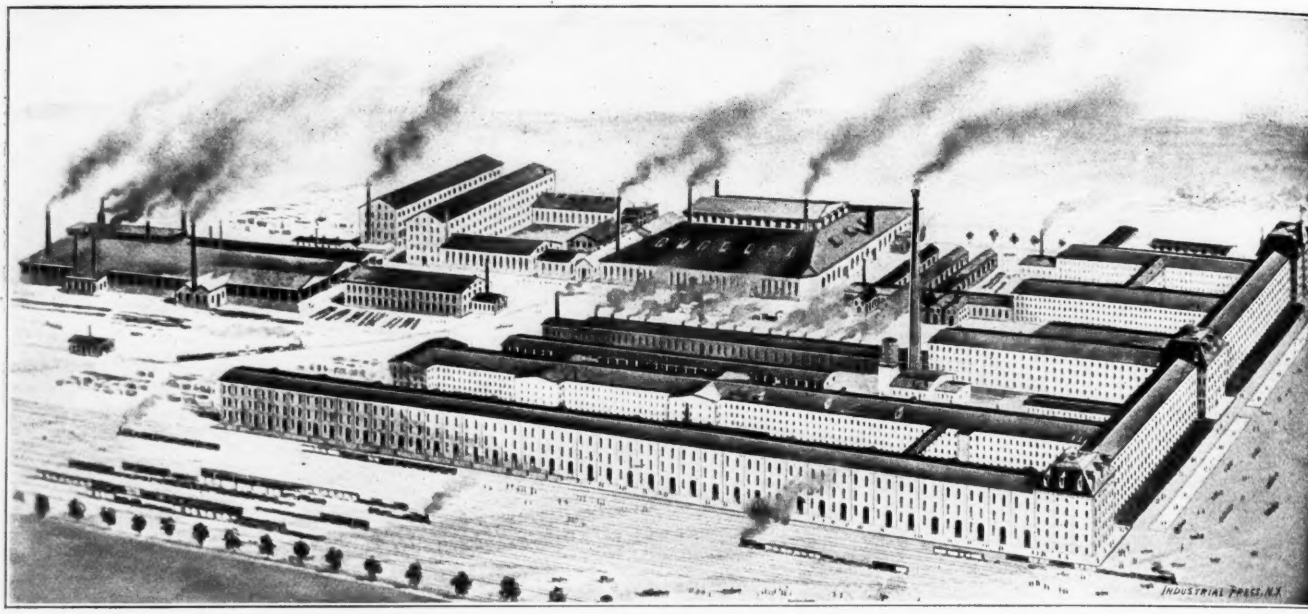


Fig. 1. The "East Street" Shops at Springfield, O., which at the time of their Construction in 1882 were said to be the Largest in the World.

The fire started in the upper story of the building at the extreme right in the illustration, Fig. 1, and rapidly spread to other parts. The Krell-French building appearing in the foreground in the illustration was the last to burn. Every possible effort was made to save this building, for the concern had just recently been established there and it represented the largest single interest in the plant. Piano cases, kiln-dried wood, varnish and other materials used in the manufacture of pianos were entirely consumed. A large number of men from the East who had been engaged to work for the company were sent back, and many others who were expected to arrive in Springfield were telegraphed not to start.

We show herewith two photographs taken of the ruins. Fig. 2 shows the ruins of the southern part of the edifice, occupied by the Owen Machine Tool Co.; Fig. 3 is of the crew from the Indianapolis Switch & Frog Co., who by dynamiting part of their shop saved this and also the Fairbanks Machine Tool Co., the Springfield Foundry Co. and other shops further back. The dynamiting was accomplished in a building at the rear of the main entrance and this heroic act of the men has made them heroes of the hour among their fellow workmen. The Southeast end of the building was saved by the prompt efforts of Joseph Markle, Thomas Goodenough and some of the employees of the Springfield Foundry Co., who, having obtained permission of the chief of the fire department to have one of

Fig. 2. View of the Ruins at the Section occupied by the Owen Machine Tool Company.

Fig. 3. Crew from the Indianapolis Switch and Frog Co., who saved a Large Section of the Works by Dynamiting Part of their Shop

the hose wagons, attached the hose to one of the back plugs and fought the fire that was raging in the pattern room, preventing it from spreading further. The brave conduct of two railroad men, Louis Underwood and James Shaffer also deserves mention. Several cars, some of which contained benzine, stood right in the path of the fire; they coupled engines onto these cars and, though it was considered extremely dangerous to go near them, they hauled them to a safe distance.

* * *

HARDENING EXTRA LONG STAY-BOLT TAPS.

E. R. Markham.

In hardening very long pieces of steel that cannot be straightened if they spring, and that will also not allow of grinding, great care must be exercised not only in the hardening, but also in the various operations of machining the metal to the desired shape. Furthermore, it is not advisable to use the highest carbon steel when a tool such as a tap or a reamer is to be made, if it is to be hardened by the method to be described below.

A stay-bolt tap 44 inches in length is, however, not a difficult job, provided we go at it rightly. The stock to be used in making such taps should be at least one-eighth of an inch larger in diameter than the finished tap, in order that its decarbonized surface, caused by the action of the oxygen in the air on the surface carbon of the steel during its various treatments in the steel mill, may be thoroughly removed in machining. After removing this outer surface of the stock by turning down in the lathe to within 1-16 inch of size, the steel should be packed in an iron box with powdered charcoal and subjected to an annealing heat, care being taken to make certain that the box is heated evenly and thoroughly to the proper temperature, which may be determined by means of test wires to be described later. The proper heat for the annealing of pieces from which it is desired to remove strains, is a bright red. This is higher than a hardening heat, but it will remove any strains, due to unequal contraction that may be in the steel incident to the operation in the steel mill, or forge. The slower the steel cools the better. The grain of the steel will become refined when it is heated to a low red for hardening.

If any of the pieces when taken from the annealing box are sprung, do not attempt to straighten them *cold;* it is best not to straighten at all. Turn the spring out; but if they are sprung too much to allow of this, heat them to a bright red, or forging heat, and straighten and then anneal them afterward as before. Much care should be taken in finish-turning, threading, or milling, that the tools are very sharp, and ground correctly, as it is an easy matter to pene a piece of steel with a dull cutting tool, this being especially true in regard to a milling machine cutter. Also a piece of work may not only be sprung by a dull mill, but it can be stretched enough to destroy the accuracy of a tap. When the taps are machined and ready to harden, it is well that they be tested between centers to see that they are true, as it is not charitable to blame the hardener for mistakes of the tool maker.

The only shape of hardening box that I should advise for use with this class of work would be one high enough to stand the pieces in upright, having at least one inch clearance space at the top and the bottom. The boxes should not be made too large; one capable of holding four taps and allowing plenty of space for packing material around them would give better results than one capable of holding more, as the heat would then be applied more uniformly. The dimensions for such a box would be 47 inches by 6 by 6 inches. The ends could be left out of the pattern and a bottom fitted into the box after the casting is made. The cover should be a little smaller than the inside of the top of the box, so it will not stick when the iron of the box becomes warped by use, and there should be some means provided for fastening it on the box securely if the furnace is not high enough to allow the box to stand upright, as not many ovens are built that would accommodate this height of box, and few furnaces would give an even heat the whole length of the box if they could hold it. The results so far as straightness is concerned would be surer if the boxes were heated on end; but if the packing-material is tamped in solidly around the taps, good results can be obtained if boxes are laid on side by making sure they are not within one-half inch of each other, or within one inch of the walls of the box at any point.

The packing material to be used consists of granulated charcoal and granulated charred leather, a sufficient quantity of which should be mixed up in equal parts of each to entirely fill the hardening box around the taps. There should be several ¼-inch holes drilled through center of cover, through which 3-16-inch wires long enough to run to the bottom of box are to be inserted before heating up the box. When the box is according to judgment heated through, it may be tested by drawing out one of these wires; if the wire is red-hot throughout its entire length, time from then; but if not, wait a few minutes and then test by drawing another and so on until finally one is drawn that is of the required evenly heated condition. The work should then be run at a low red heat for two hours for a 2-inch tap, and smaller ones for a correspondingly shorter time. At the expiration of this time the box should be removed from the furnace, stood on end with the cover up, and the cover then removed. Then with a suitable pair of tongs the taps should be drawn out carefully through the packing-material to avoid springing, and immersed in a cooling bath of raw linseed oil, which should be kept cooled by circulation through a coil of pipe immersed in cold water. The pieces should be plunged straight down into the center of the bath and worked up and down steadily until the red has disappeared, when they can be moved to the edge of the tank, by still being worked straight up and down. Another person could in the meantime take the second tap from the box and manipulate in the same manner, so that in this way two men can handle the four taps all right, as the packing material will keep the others hot until their turns come.

It is quite necessary that the contents of the cooling bath should be agitated in such a manner that the oil will flow from the edges of the tank toward the center. This forces any vapor formed by contact of the heated steel and oil away from the work, doing away with the tendency to form soft spots on the work. The tank for the bath should be at least 60 inches deep and from 42 to 36 inches square. It should be set in a large tank of water and one or two pumps of suitable size should be connected with the tank to draw the oil from near the top of the bath, force it through coils of pipe immersed in the water tank, and then back into the oil tank about 18 inches below the surface. If these two pumps are connected to the tank opposite each other the oil should be agitated sufficiently by these two streams thus forced toward each other. The oil in tank should never be allowed to get as low as the suction pipe, or air will become mixed with the oil in the jet.

They should be left in the bath until they are cold, after which the temper must be drawn. The most satisfactory method of drawing the temper on such work is in a kettle of hot oil, gaging the heat by means of a thermometer or pyrometer. The dish that it is heated in should be long enough to allow the taps to lie lengthwise, and blocking should be put in to hold them up 2 or 3 inches from the bottom by supporting them every 6 or 8 inches to avoid any tendency in them to spring. The dish should be placed over a gas pipe to which are attached several burners which should be located 4 or 5 inches apart. The thermometer should be placed in the oil standing nearly vertical, but should not go deeper down than the taps. The oil in the dish should be kept in motion by gentle stirring, but care should be taken not to "slop it over," as it might take fire.

The amount to which the temper must be drawn will depend on the amount of heat the pieces have received and the nature of the stock they are made of; but if the directions given are closely followed 500 degrees Fahr., will probably be found about right. As stated before, the oil used in the bath should be raw linseed. The hardening boxes must not be made open on one side instead of on the end, for to lift the taps and draw them through the packing material from such a box when they are red-hot is sure to spring them. Also no attempt should be made to use anything in place of charred leather.

In packing the taps in the packing material set them with the wrench end at cover end of box and lute the edges of the

cover with fire clay mixed with water to the consistency of dough. Also use tongs of suitable shape for the work. In cooling the taps plunge them straight down into the bath quickly enough to prevent the oil from flaming up. Do not have the face directly over the bath, but protect the face as well as the hands and arms. It is best for this reason to have the top of tank about 6 inches above the level of the floor, or to build a platform to stand on when dipping the work. It must be remembered that very much depends on how the pieces are machined. The steel, if it springs in annealing or machining, must not be straightened.

* * *

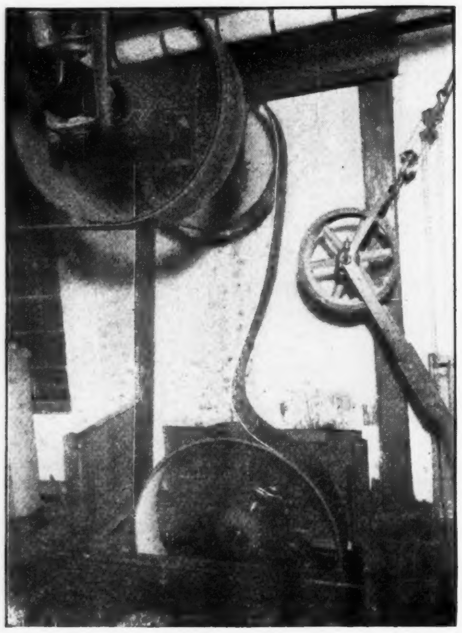
A MAMMOTH WRENCH.

The accompanying illustration is of a wrench manufactured by J. H. Williams & Co., Brooklyn, N. Y., for use on the nuts of foundation bolts, flywheel rim bolts, and flywheel journal boxes. Its weight is 150 pounds, length 59 inches, opening $7\frac{5}{8}$ inches, for the nut of a five-inch bolt. It is styled by the makers the "largest drop-forged wrench in the world," a claim which we think will not be disputed. The die used in forging the head of the wrench weighs 1,300 pounds. This wrench is the "master" of a line of 15-degree angle tools brought out by Mr. Williams seventeen years ago, the smallest of which is a No. 00 wrench, which weighs but one-eighth ounce. Large drop-forged steel wrenches are so much stiffer and better than the wrought iron wrenches that have heretofore been used that they will be appreciated by those who have to erect heavy machinery.

* * *

HOW A BELT WILL ADHERE TO A PULLEY.

In the last number we described a rope drive with loose belt, in which a narrow "keeper" belt was used on the outside of the main driving belt to keep the latter in place. Incidentally we mentioned that a loose belt, kept in contact with the



Vertical Belt running without Initial Tension.

driving pulley, by a binder pulley, will sometimes show a marked tendency to follow the periphery of the driving pulley after the binder pulley has been withdrawn. As a further illustration of this, the Cling Surface Mfg. Co., Buffalo, N. Y., have sent us a photograph from which the accompanying illustration was made. It shows a vertical belt, connecting two pulleys which were in rotation when the photograph was taken. The binder pulley is raised away from the belt, yet the latter continues to follow the contour of the driving pulley.

The belt was treated with the "Cling Surface" preparation made by this company, which produces sufficient friction between the belt and pulleys to make any initial tension in the belt unnecessary. Particulars with regard to the drive are as follows: Width of belt, 14 inches; diameter of driving pulley, 64 inches, and of driven pulley, 42 inches; speed, 1,450 feet per minute; distance between centers, about $10\frac{1}{2}$ feet. The belt is driving a dynamo supplying current for 500 c. p. lamps, and in addition the overhead countershaft drives another countershaft connected to a second dynamo. Formerly the belt was made to adhere to the pulleys sufficiently to carry the load by the use of the binder pulley. The Cling Surface Mfg. Co. write us that this is the second case they have heard of where a vertical belt is running under these unusual conditions and yet transmitting the full amount of power.

* * *

DEATH OF FRANCIS A. PRATT.

Francis A. Pratt, ex-president of the Pratt & Whitney Co., of Hartford, Conn., died at his home on Feb. 10th last. Mr. Pratt was born in Woodstock, Vt., in 1827. At an early age he began to interest himself in mechanics, and became noted for a number of inventions quite remarkable in a mere lad. He learned the machinist's trade at Lowell, Mass., and in 1848 he entered the employ of the Gloucester Machine Works, Gloucester, Mass., and later the Colt Works at Hartford. Still later he became superintendent at the Phoenix Iron Works, and in 1861 he, with Mr. Amos Whitney, who also was employed at the Phoenix shops at that time, founded the firm of Pratt & Whitney. Some of the first work of the new firm was for the Willimantic Linen Co. In 1862 Monroe Stannard, of New Britain, was admitted to the firm, each of the members contributing $1,200. In 1865 the first of a group of buildings was erected that now constitute the Pratt & Whitney establishment. The company was incorporated under a charter from the State in 1869. The capital was $350,000. It was afterward increased to $500,000 from the earnings. Mr. Pratt became the president, and Mr. Whitney superintendent of the works. Mr. Pratt did considerable traveling during his life in the interests of his company and secured a large amount of foreign business. He was highly esteemed by scientific men and, together with Theodore N. Ely, superintendent of motor power of the Pennsylvania railroad and Robert H. Thurston of Cornell University, was appointed a member of the board of commissioners on expert examination of the treasury vaults by the Secretary of the U. S. Treasury. He also filled other important positions. Mr. Pratt was identified in several industrial corporations and was a prominent member of a number of societies.

* * *

SPRING MEETING OF THE A. S. M. E.

As previously announced, the semi-annual meeting of the American Society of Mechanical Engineers will be held in Boston, from May 27th to 30th. At a meeting of the chairmen of the several committees recently held in Boston the following report of completed arrangements was made:

Tuesday evening, May 27th—the opening session.—A reception and luncheon for the visiting members, at which Mr. Pritchett, president of the Mass. Inst. Technology, will preside.

Wednesday morning.—A business and professional meeting. In the afternoon a visit to the laboratories of the mechanical, mining, chemical, electrical and marine departments of the Massachusetts Institute of Technology. In the evening, a meeting at which will be submitted papers, designs and discussions.

Thursday morning.—Professional meeting; excursion down the Bay and a visit to some of the industries thereabouts. Reception in the evening.

Friday morning.—The society will meet at Harvard University, Cambridge, as the guests of President Elliot. Visit to the laboratories of the University in the afternoon.

The following gentlemen have been appointed chairmen of committees: Prof. Gaetano Lanza, on meetings; William L. Church, on entertainment; George L. Stoddard, on excursions; W. W. Bird, on finance; and C. H. J. Woodbury, Robert S. Hale, and Francis H. Boyer, treasurer, secretary and chairman respectively of the General Committee.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

The Reliance Machine & Tool Co., Cleveland, O., manufacturers of the Morgan bolt cutters, have brought out a special machine for threading the ends of pipe after it has been coiled. It will hold and thread coils up to 40 inches in diameter. It has the same style head as used on the bolt cutters made by this company.

JEWELERS' AND TOOLMAKERS' ANVIL AND BASE.

The anvil and base illustrated by Fig. 1 is made by the Billings & Spencer Co., Hartford, Conn., for the use of mechanics like jewelers and toolmakers who have need for a light anvil on small and delicate work. The base is drop forged and is furnished either color casehardened or nickle

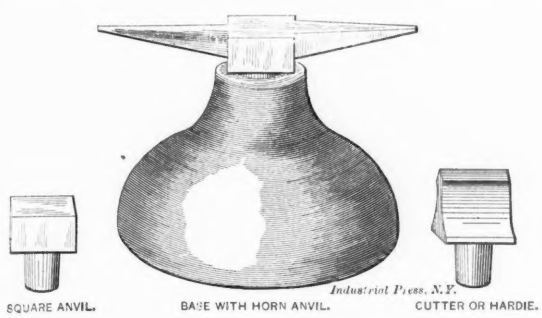


Fig. 1. Toolmakers' Anvil.

plated. A square anvil, a horn anvil and a hardie are furnished with the base. These are drop forged and hardened. Altogether the tool is a handsome specimen of the product of the company and will undoubtedly make a welcome and useful addition to the kit of almost any toolmaker and machinist working on small machine parts.

NEW MACHINISTS' TOOLS.

A short time ago we stated that the Brown & Sharpe Mfg. Co., Providence, R. I., had brought out a line of spring calipers for outside and inside measurements and of spring dividers, all fitted with a new design of spring nut which can be easily adjusted either by turning or by sliding on the screw at will. This firm has now brought out a line of calipers and dividers listed under the head of "Rex," which are designed to meet the demand for a less expensive instrument than the "Brown & Sharpe" calipers and dividers. They

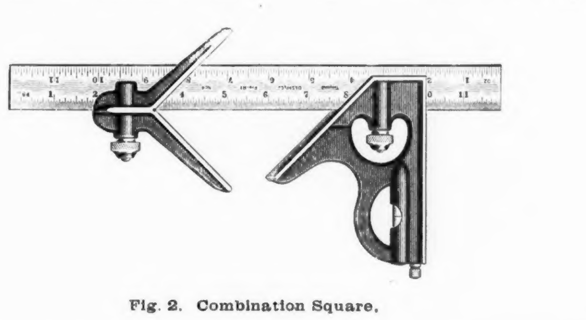


Fig. 2. Combination Square.

are made with the same care as to essential details as the more expensive line, and have the same style spring nut, which operates on the principle of the spring chuck, is carefully hardened and has no loose pieces. The adjusting screw of the new line of tools is hardened.

The Brown & Sharpe Mfg. Co. have also brought out a new combination square which will attract the attention of mechanics in that the heads are of steel drop forgings instead of the usual cast iron. This makes a very light and strong square, and one that is very durable. The blades are either soft or tempered, as desired. This tool is shown in Fig. 2.

TOOLS FOR LATHE, PLANER, ETC.

The Armstrong Bros. Tool Co., Chicago, Ill., have just brought out two new tools, cuts of which are shown in Figs. 3 and 4. Fig. 3 is a planer jack for leveling work on a planer, milling machine, etc. The base is of malleable iron, faced true. An important feature is a split hub and screw (case hardened), which provide a convenient means for lock-

Fig. 3.

Fig. 4

ing jack screw in position and of compensating for wear of screw and socket. The tilting cap is of malleable iron, faced on the top, and is attached to head of screw by ball and socket arrangement, thus adapting it to uneven, irregular or angular surfaces. The screw is made of steel with U. S. standard thread and has a hexagon neck for the wrench. This tool is made in four sizes.

The lathe dog, Fig. 4, combines the features of the clamp dog with the simplicity and strength of the ordinary lathe dog. It will accommodate itself readily to work of any shape, and is especially adapted for use on finished work which would be liable to be damaged by the setscrew of an ordinary lathe dog. The sliding block is drawn up to the work by a loose fitting U bolt of steel, threaded on the ends and with case-hardened nuts, loosely fitted, so that they can be run rap-

Fig. 5.

idly to size without using a wrench until tightened. The body of dog is cast of steel; there are no projecting screws or other parts liable to catch the file or the workman's hand or clothing, and it can be adjusted without removing work from centers. It possesses a wide range of adjustment, the seven sizes in which it is made taking work from 1/8 inch up to 5 inch in diameter.

In Fig. 5 is a tool designed for use in holding straight shank drills, reamers or similar tools, with safety to the operator and without injury to the tool itself. In construction it is similar to the Armstrong lathe dog and needs no further description.

TENSION GAGE FOR MEASURING MACHINE.

A measuring machine has been brought out by the John M. Rogers, Boat, Gage and Drill Works, Gloucester City, N. J., on which is a device for gaging the pressure of the anvils on the piece being measured.

The machine is fitted with two heads, one movable and the other stationary, and to the latter is attached the tension gage composed of levers *B* and *C*, Fig. 7, the former having on the upper end a yoke spanning the spindle and connected to it on each side by links *A* and turning on the trunnion just below the spindle. Levers *B* and *C* are connected at the lower ends with a link, and lever *C* turns on a trunnion just above this link, the trunnion being placed above instead of below the link, so as to avoid any false movement which might be caused by flexure should the lever *C* swivel on a trunnion pin placed below the connecting link.

In order to set the dial of the machine at zero, the measuring points are brought in contact and sufficient pressure is exerted on the spindle in the stationary head to move lever *B*, and in turn lever *C*, until the graduation on the end of lever *C* coincides with the graduation on plate *E*. The index pointer on the dial must then be set at zero, and the spindle in the movable head can be run back and

the operation repeated an indefinite number of times, by different operators, and the zero on the dial will be brought exactly opposite the index pointer each time, if the graduations on C and E are made to coincide. After the pres-

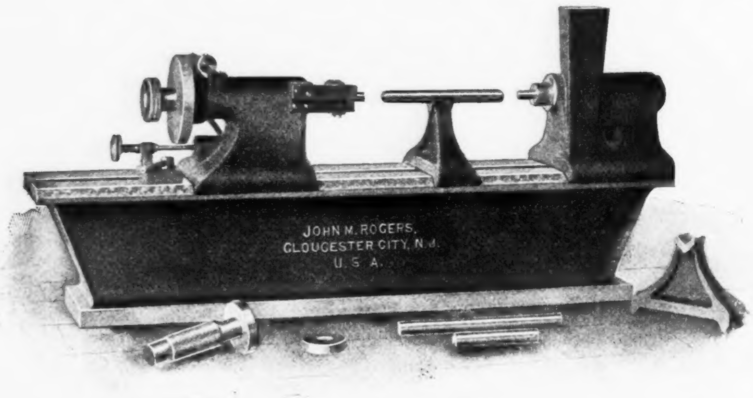


Fig. 6. New Measuring Machine.

sure is relieved from the measuring points the levers are carried back to their original position by the helical spring operating against the back end of the spindle and the weight D operating on lever C. The spring exerts sufficient pressure to keep the work square with the measuring points, which is particularly convenient when long and heavy gages are being handled.

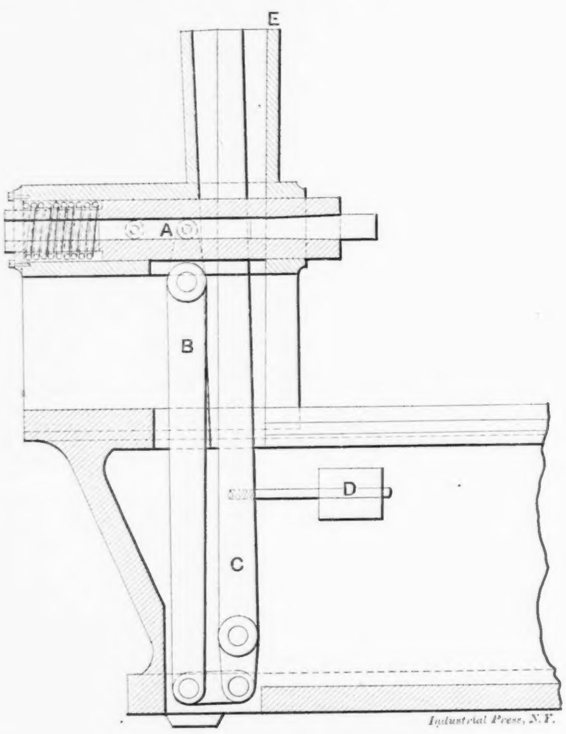


Fig. 7. Details of Tension Device.

The screw in the movable head has a 50-pitch thread and the dial is graduated to 400 divisions, giving direct readings to the 1-20,000 (.00005) part of an inch.

The bed is massive and is supported on three feet of small area, hence is not easily affected by changes of temperature or flexure; the heads are carefully fitted to insure perfect alignment of the spindles and parallelism of measuring faces at any position, up to the capacity of each machine. These machines are now built in two sizes, viz., 0 to 12 inches and 0 to 24 inches, and are also furnished to measure in the metric system.

THE WHITNEY VERTICAL DEEP-HOLE DRILLING MACHINE.

In the past the generally-employed means for deep-hole drilling whether in gun barrels, lathe spindles, or other work, has been horizontal machines known as drilling lathes. In fact the idea seems to be quite generally entertained that deep-hole drilling cannot be done successfully in any other than a horizontal position notwithstanding the fact that vertical drilling machines have been successfully employed on deep-hole work. In consequence of the practice of generally using horizontal drilling machines, the gun-barrel drilling department of an armory requires a great deal of floor space. The machines are driven by a forest of belts and a maze of countershafts. Where the machines are closely crowded together, not a little skill and management are necessary to get the countershafts placed so as to prevent interference.

The new drilling machine made by the Whitney Manufacturing Co., Hartford, Conn., will be regarded as an innovation if not a revolutionary departure in the practice of deep-hole drilling as it is not only vertical, but contains other features of a radical nature. The first machine built is in use at the Springfield Armory and so well is it liked that the commanding officer has ordered fourteen similar machines. These machines, however, are not designed for drilling holes as deep as required in rifle barrels, being limited in capacity to holes 15 inches deep and 1 inch in diameter. They are used for drilling lock-bolts, the holes being about 5 inches deep. There is, however, no bar to building them for deeper holes, and such machines will undoubtedly be made before long. In the event of their being built for drilling long holes, the vertical column will be carried down by the side of the base instead of being mounted on top of it, as in this case.

The drill is held stationary with the point upward and is readily removed for sharpening. The vertical feed is automatic and may be varied by changing wheels in the train of gears shown at the left of the head. A notable feature of the feed mechanism is that it will drill to exact depths, the stop

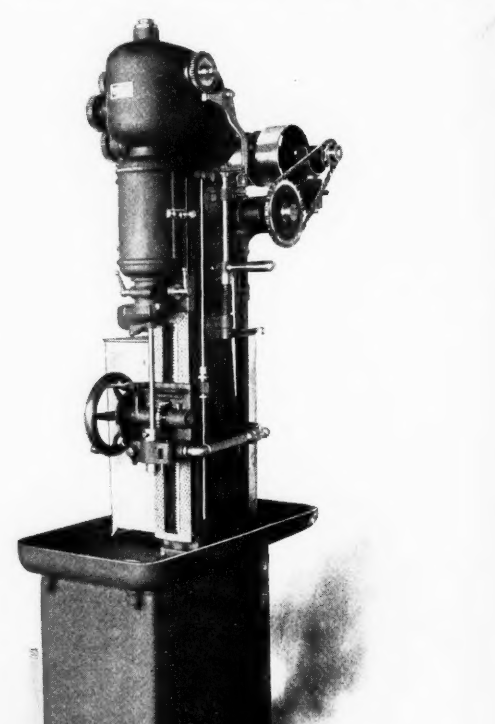


Fig. 8. Vertical Deep-hole Drilling Machine.

motion acting positively and instantly. It has a fine adjustment, and when the spindle reaches the prescribed depth, the knock-off throws out the driving clutch and throws on a brake, stopping the spindle and also the oil pump. The oil is forced upward through the drill, and the chips and oil flow out through a spout into the galvanized tank shown at the side of the column. As the drilling is done vertically and from the

bottom, gravity assists in freeing the hole of oil and chips. The work is held in a fixture forming a part of the revolving spindle. This fixture is concealed in the cut by a door which is opened to insert and remove the work. Each machine is driven by only one belt from one overhead shaft. The oil pump is driven by a chain, and as the pump wears and requires more speed the sprockets are changed to speed it up.

The vertical type of deep-hole drilling machine, has a number of important advantages. It requires less floor space, making it more easily attended and enabling the operator to work more machines than with the horizontal type. Fewer belts, countershafts and shafting are required, which means less power, less expense for belting, maintenance, etc. The feature of having the chips discharge into a chip tank saves labor. The oil and chips fall into the tank which has a strainer in the bottom. The oil drains back into the base of the machine to supply the pump, leaving the chips. When the chips are to be taken away, the attendant removes the tank and substitutes another for it.

DOUBLE COMPRESSION COUPLING.

The cut shown herewith, Fig. 9, is of a new shaft coupling recently placed on the market by the W. P. Davis Machine Co., Rochester, N. Y. It consists of a rim with three arms supporting the hub and of four compression flanges which are bored to the same taper as the hub and which fit the hub. The ease with which this coupling can be put on the

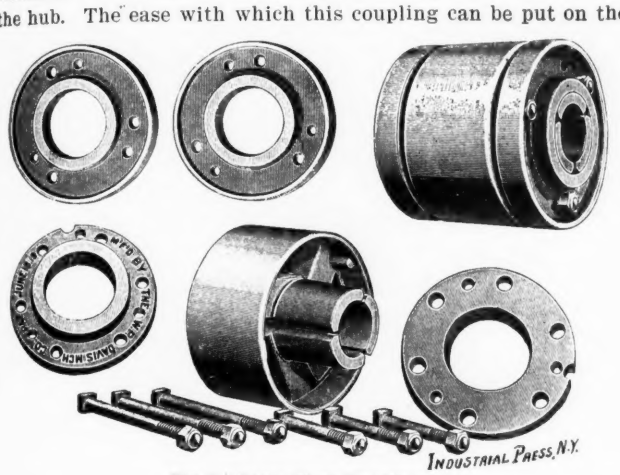


Fig. 9. Davis Shaft Coupling.

shaft and the perfect alignment that is secured are its especially good features. The coupling is first put on the two pieces of shafting, each shaft being pushed to the center of the hub. The first two compression flanges are drawn up securely by three bolts, and the outside flanges are then drawn up by three bolts running through the four flanges but drawing only the two outside ones. This produces sufficient compression to drive any line shaft for which the coupling is intended. If it is desired to use a feather or key, however, the hub of the coupling is thick enough to allow its use. In case the shaft runs "out" after the coupling has been applied it can be aligned by screwing up the bolts on the "high" side With this style of compression coupling no fitting is required, which saves much time and expense. To remove the coupling, the bolts are taken out and screwed in holes provided for that purpose in the compression flanges. This forces the flanges off the hub and the coupling can then be slipped off.

CENTER GRINDER.

Some time ago there was illustrated in MACHINERY a chain-driven center grinder manufactured by L. S. Heald & Son, Barre, Mass. The emery wheel in this grinder is operated by hand power and the grinder itself attaches to the tail spindle of the lathe, insuring that the grinder will always be set at the correct angle even if the tail center is set over for turning tapers. With this construction it is not possible to get the grinder incorrectly located, as might be the case if fastened to the tool block of the carriage. In Fig. 10 a similar machine is illustrated, made by the same company, but having a motor attached for driving the emery wheel. As usually constructed it grinds only the standard angle of 60 degrees or 55 degrees as may be preferred; but it is also made with the frame in two parts so it can be adjusted for other angles.

This firm have also brought out a power-driven center grinder shown in Fig. 11 for use on lathes where it is desirable to obtain the power for grinding from the lathe itself. In this case a friction roll is mounted in a frame clamped to the bed of the lathe and bears against the front of the large step of the cone. It transmits power to the grinding spindle through a universal joint at the right-hand end of the shaft shown in the illustration, and to a pair of bevel gears

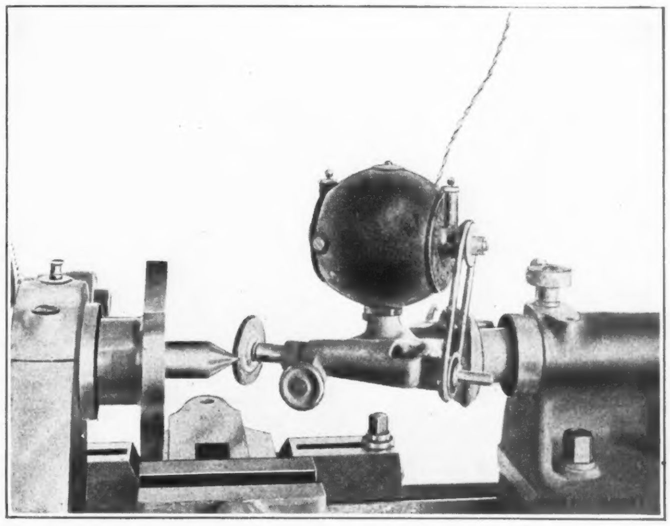


Fig. 10. Electrically-driven Center Grinder.

which are encased. Like the other styles the frame is clamped to the tail spindle and can be made adjustable if desired. The universal joint allows the power to be transmitted easily at any angle, and a fiber gear allows the spindle to run at high speed without noise. All these grinders are adjustable to the lathes without regard to faceplates, toolposts, or any troublesome connections.

NEW FRICTION HEAD LATHE.

In Fig. 12, page 36, is a cut of a new 28-inch lathe with friction head built by Fay & Scott, Dexter, Me. The lathe has double back gearing with ratios 12 to 1 and 7 to 1, and four steps on the cone, giving twelve spindle speeds. The ratio of the back gearing is changed by sliding a feather in the quill of the back gear spindle. This is accomplished by sliding a sleeve one way or the other on the outside of the quill, the feather being attached to the sleeve. When the sleeve is in one extreme position the feather makes

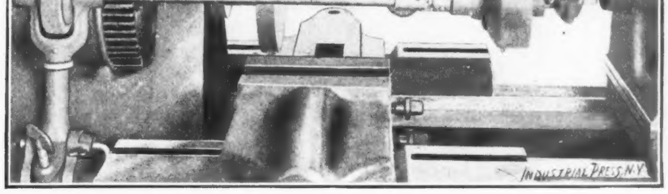


Fig. 11. Power-driven Grinder.

one of the back gear pinions fast to the quill; and in the other extreme position the first pinion runs loose on the quill and the other one becomes fast to it.

Friction back gearing is fast coming to be a very important detail on engine lathes, since it enables the operator to make quick changes from slow to fast speed by throwing in the direct belt drive of the cone or the back gear drive

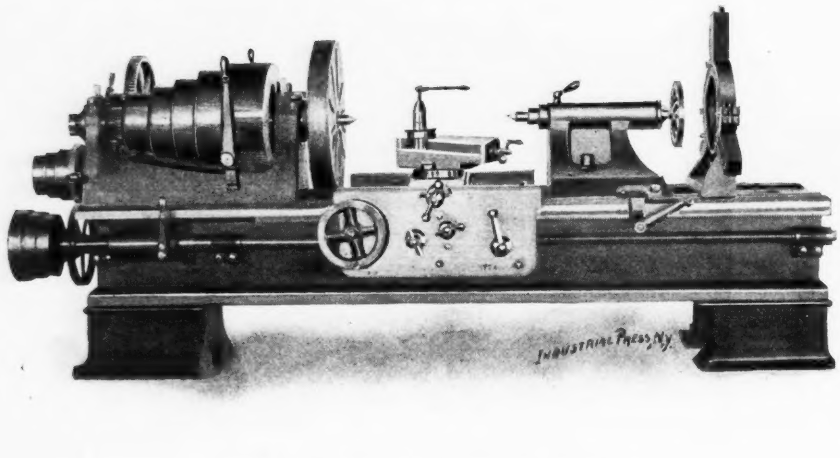


Fig. 12. Fay & Scott Twenty-eight Inch Lathe.

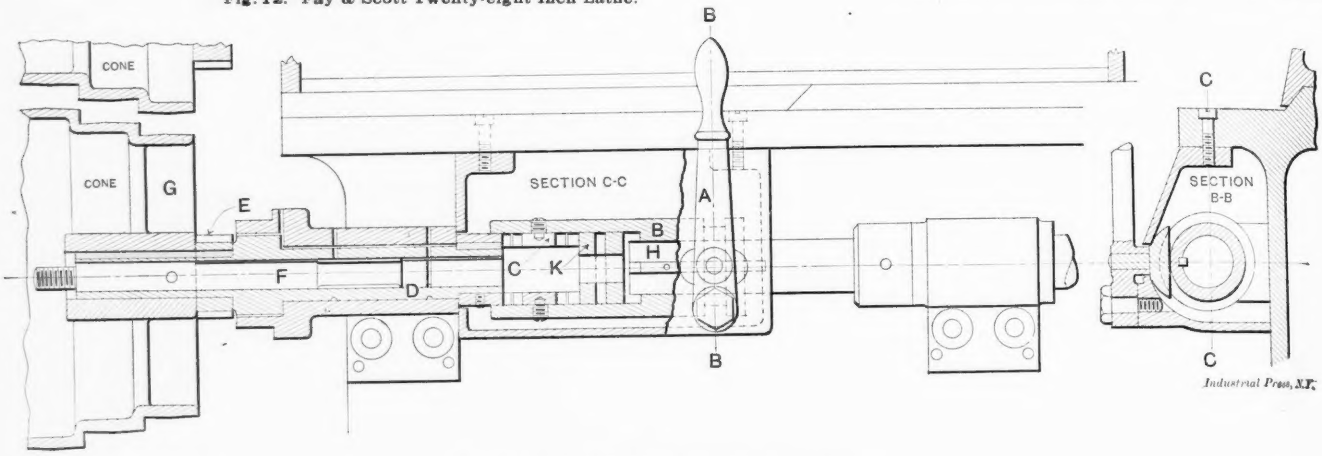


Fig. 13. Details of Lathe Lead Screw Mechanism.

as desired, while the lathe is in operation. Such an arrangement adapts the lathe to the various processes of roughing, finishing, thread cutting, etc., without loss of time in making the change and is found especially useful on this lathe in connection with the lead-screw clutch shown in detail in Fig 13. The friction clutch used in this lathe is of the expanding brake strap type, the strap being expanded by toggle joint levers which are readily adjustable. The back gears can be thrown in or out in the usual way by an eccentric.

The feed mechanism and lead-screw clutch above referred to are special features of this lathe and are patented. In the sectional view will be seen an upright lever *A* which, by means of a fork, operates a sliding sleeve *B*, inside which is a clutch *C* secured to it by the two screwed pins. This engages either with a clutch keyed on the end of a hollow shaft *D*, whose other end carries a change gear *E* or else it engages with a clutch *K*, pinned on the end of a shaft *F*, passing through the hollow shaft and carrying the feed cone *G* at its other end. In either case the sliding sleeve *B* transmits the motion from the clutch attached thereto to the lead-screw *H*, which also acts as a feed rod.

This lathe can also be furnished with an automatic, revolving turret on the bed, with power feed. Also with taper attachment and turret tool block interchangeable with the regular compound rest, this making a combination turret engine lathe with sufficient power and massiveness to machine any piece within its range with the greatest economy.

GOULD & EBERHARDT DRILL PRESS.

The 25-inch upright drill press made by Gould & Eberhardt, Newark, N. J., has recently been remodelled and adapted for electric driving. The illustration, Fig. 14, was made from one of a lot of machines which have just been shipped to the new U. S. Government printing office in Manila, P. I. The motor is mounted on brackets at the side of the machine, and drives the lower cone by a belt having a tightening pulley which is arranged so that it may be easily adjusted. The switch for the motor is placed where it can be conveniently reached by the operator. The table and arm are raised by a bevel gear and screw similar to the larger sizes of drills instead of by a rack and pinion on the column. The screw is centrally placed so as to give direct support to the table.

The machine is equipped with the various features and attachments that are supplied with the standard drills made by this company. These include the indexes for the belt feeds for the various size drills; automatic stop and depth gage; back gears so arranged that one movement of the lever releases the cone from the shaft and engages the gearing, while one movement in the opposite direction disengages the gearing; and feeds independent of belt speed, etc.

The illustration furnishes a good view of Eberhardt's patent automatic tapping attachment which, although not new, is a feature of considerable interest. This attachment is used for tapping holes after they have been drilled, the work being rapidly moved across and centered under the tap by means of the oblong, compound traverse table. This tapping attachment can be used for tapping holes, either bottoming or through, large or small, up to its full capacity. After it is set and

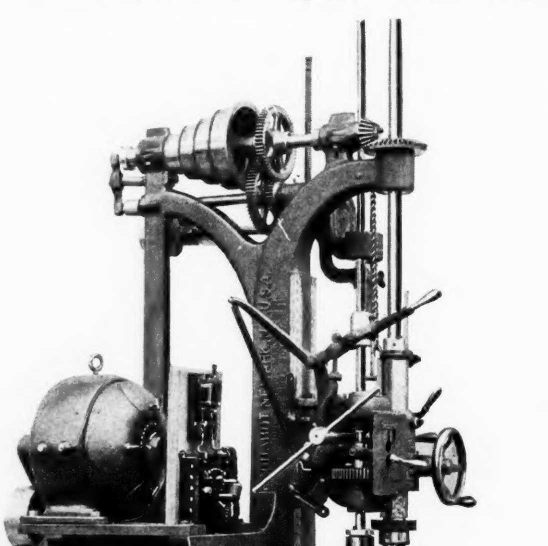


Fig. 14. Electrically-driven Drill Press.

started, it will go to the proper depth, reverse and run back, and is ready again for the next hole. It is provided with a safety friction device which relieves the strain and prevents the tap from breaking should it strike the bottom of the hole or from any cause become fast in the work. Drills of this style are made in six sizes from 25 to 50 inches.

* * *

ADJUSTABLE COLLAPSIBLE TAP.

The Geometric Drill Co., New Haven (Westville Station), Conn., have recently brought out an improved adjustable collapsing tap; also a new self-opening die-head. The tap is illustrated by Figs. 1, 2, 3 and 4, and the new die-head will be illustrated and described in a future issue.

The cutters fit closely in their slots so that chips cannot work in and clog the action. To remove them the plate *S*, held by four screws, is taken off and the cutters pulled off the springs longitudinally. The cutters are adjusted for cutting variable diameters by means of the micrometer adjusting screws *J J*. These screws abut against a pin set in the ring *H*. The ring *H* also carries the catch for holding the ring *B* in the position for cutting a thread. Consequently shifting its position changes the position of *B* and of *E*. If a larger diameter thread is to be cut, the adjusting screws are so manipulated that the corners of *E* are turned further under the cutters, lifting them slightly higher; for a smaller diameter thread the adjusting screws, of course, are set so that *E* is not turned so far.

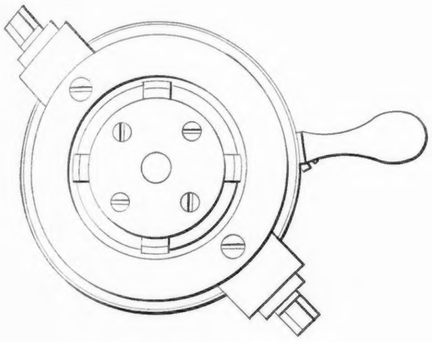


Fig. 1

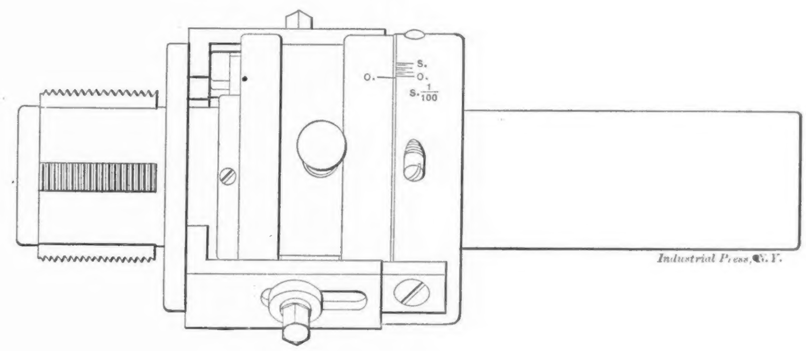


Fig. 2.

The advantages of a collapsing tap are fully as many as those for a self-opening die-head, but because of constructive difficulties it perhaps has not been made and used so extensively. The collapsing tap shown herewith is, however, a solid and substantial tool which will do more and better work than the solid tap, especially in the larger sizes. Little time is lost in removing the tap from a hole, and as the tap is never reversed, there is little or no dulling and grinding off of the sides of the thread which so quickly wears out a solid tap, especially when working cast iron and being reversed at high speed.

Figs. 1 and 2 show end and side views of the exterior of the tap. Figs. 3 and 4 show the interior construction with the exception of a few minor details. The shank *A* carries the four cutters *C C C C* which set in four slots milled across the end. The cutters are shown in position for tapping a thread. When the stop *O* comes in contact with the work being tapped, the ring *G*, Fig. 4, is forced upward on the shank by the connections *P P*. These connections are adjustable for varying

The spring *F* is provided for holding *G* and connected parts, in threading position, that is, down against *B*. A pin through *G* passes through the shank *A* and under the shoulder of *N*. Where it is desired to have the tap collapse when it bottoms in a hole, the part *E* is drilled and provided with a spindle passing through it longitudinally. The spindle when pressed against the bottom of the hole, moves the part *N* upward and collapses the tap the same as though the part *O* had come in contact with the work.

* * *

NUTTING'S AUTOMATIC MULTIPLE SPINDLE DRILL PRESS.

An automatic multiple spindle drill press has been placed on the market by the National Automatic Tool Co., Dayton, O., which is entirely new in design and principle and has many novel features. It is intended for jig work where pieces are to be made in quantities and is a distinct departure from multiple drills of the usual type, because of its automatic features. A fair idea may be had of the capabilities of the

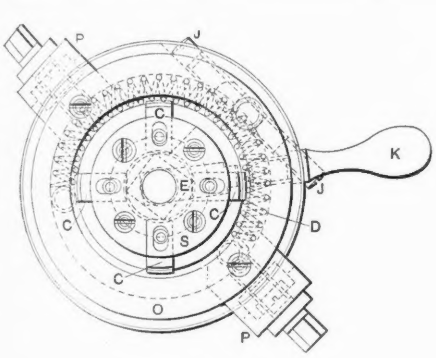


Fig. 3.

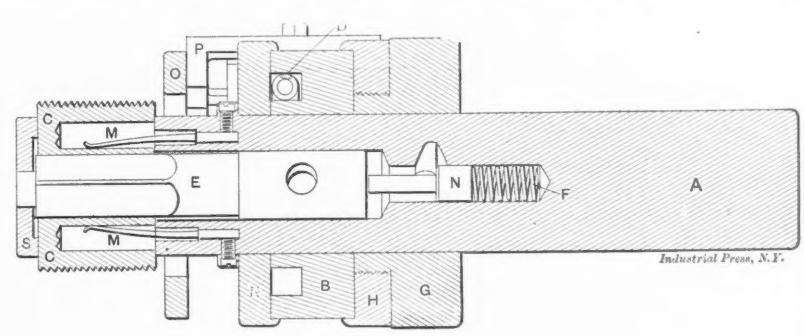


Fig. 4.

depths, having slotted holes for the binding screws. When the ring *G* is forced upward, it releases the ring *B* carrying the handle *K*. The ring is automatically retracted by the coil spring *D* which extends nearly around the tap. The movement of the ring *B* is about one-eighth of a circle, and is communicated to the part *E* by means of a pin passing through a slotted hole in the shank *A* and engaged with the hole shown in *E*. The part *E* has a squared portion which is shown with the four corners holding out the cutters in position for threading. When the ring *B* is retracted, the flat parts come beneath the cutters and thus allow them to be moved inward by four flat springs, two of which are indicated by *M M*.

new machine as compared with the ordinary multiple spindle drill press by saying that the two are related in about the same way as are the modern automatic screw machine and the more familiar monitor screw machine. The automatic screw machine cannot do all screw machine work to advantage, but where the work is adapted to it the saving through increased output is very great. In like manner the automatic multiple spindle drill press cannot do to advantage all the work usually accomplished by multiple spindle drills, but where it is adapted to the articles manufactured it will effect a great saving of time, labor and floor space. It may either operate on pieces, all of which are alike, or six totally different classes of work may be carried along at the same time. It may be

adapted for either wood or metal work and one operator can easily run two or more machines, according to the nature of the work.

The general principle of operation is as follows: The machine is equipped with six groups of drills on a six-sided turret. Each group is brought into position for drilling in turn. The table carrying the work is fed up to the drills by a cam

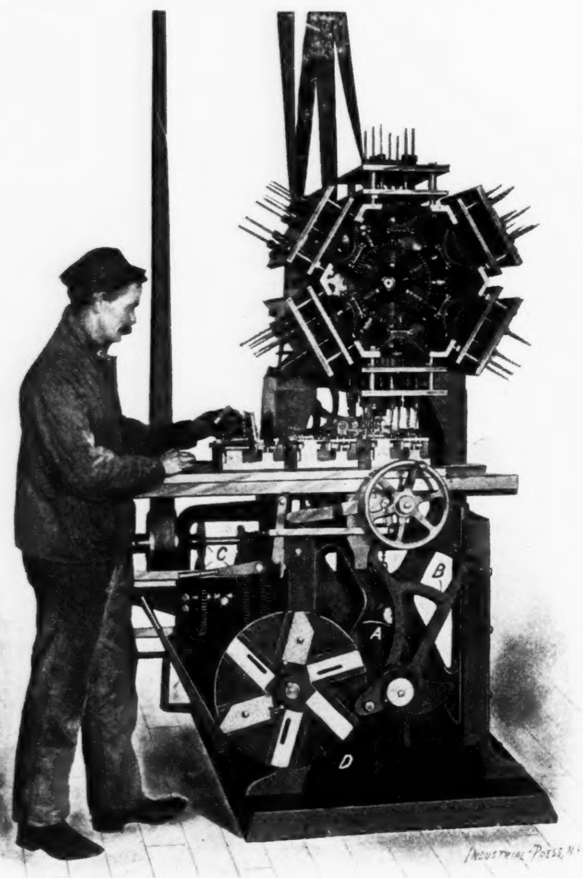


Fig. 1. Automatic Multiple Spindle Drill Press, Front View.

motion, and the speed of the feed can be changed at will or it can be arranged to change automatically to suit the conditions under which the different groups of drills are to operate. The table also has a longitudinal motion and is moved and indexed automatically in order to bring the different jigs into correct position for drilling in succession. The operator ordinarily stands at the front of the machine, but in Fig. 1 is at one side so as to more clearly expose the working parts. In this illustration the machine has just left the starting position and the drills have begun to enter the bushings of the jig. The starting and stopping levers are within easy reach and control the machine instantly. While the machine works on the first jig, which is the one at the right, the operator unloads and loads the third one and while the machine works on the second or middle jig he loads the first one, and so on.

Drills up to 5-16 inch can be used on this size machine. Each spindle is hardened and ground, runs in bronze bushings and has a ball thrust bearing. The entire six groups on the turret head and the jigs on the platen can be removed bodily and others put on in 30 minutes. None of the drills rotate except when in position for drilling, which adds very much to the life of both machine and drills. In a run of 10 hours the different spindles are in action only about one hour and as the drills have a chance to get entirely cold between each set of holes they require regrinding very infrequently. In addition to the drills attached to the turret there is a set of horizontal drill spindles for drilling at right angles to the table of the machine which, however, are not clearly visible in the illustrations.

The mechanical movements are quite simple and can be traced by reference to the engravings. The vertical drills are operated by a shaft extending through the turret head, by means of bevel gears clearly visible in Fig. 1. This shaft is driven by a belt and pulley shown in Fig. 2. The lever, *F, F*, in Fig. 2, is operated by a cam at the base of the machine and gives the turret its intermittent motion through the rolls on the disk, *G*, Fig. 2, which disk is notched at regular intervals for the locking pin or bolt, which holds the turret in position for drilling. The table is raised for feeding the work to the drills by the cam, *A*, Fig. 1. This cam is on a shaft driven by a worm and worm wheel at the rear of the machine and the speed of the worm which does the driving is determined by the group of gearing at *C* (in both views). These gears give three speed changes, by the movement of a clutch controlled by a lever bearing against the periphery of wheel, *E*, Fig. 2. Cam blocks attached to the edge of wheel, *E*, give a greater or less movement to the lever, as the wheel revolves, according to the thickness of the blocks, and so move the clutch to the desired position through the action of the lever.

The indexing of the platen is done by the large toothed sector seen at the front in Fig. 1. Underneath the platen is a toothed rack with which a pinion on the hand wheel shaft engages. Motion is given to this by the action of the sector when the table is in its lowest position. At this point in the operation of the machine a roll on the short arm of the sector comes in contact with a cam plate bolted to the face of disk *D*, and the rotation of the disk gives motion to the sector and so spaces the table. The indexing bolt for the table is also operated at the same time. The principle of the indexing mechanism and also of the speed of the feed for the table is not unlike that employed in "camming" an automatic screw machine, where the time and extent of the movements are governed by the shape and location of the cams.

As indicating what may be accomplished on this machine it may be explained that the particular job being done when the photographs were taken was the cast-iron face plates for the arm of a high grade sewing machine. There are 15 holes to be drilled in each piece, varying from No. 40 wire gage to

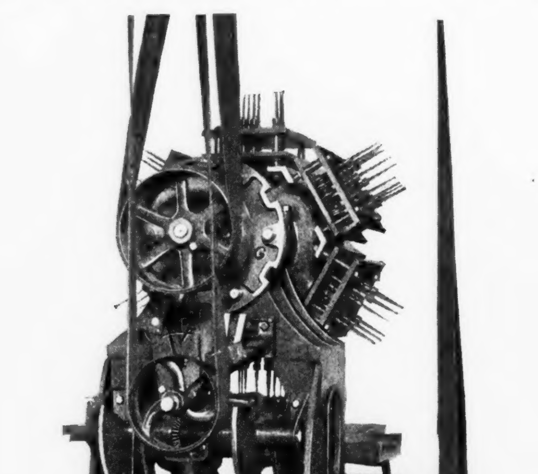


Fig. 2. Rear View of Drill Press showing Operating Mechanism.

5-16-inch diameter, including six horizontal holes. Three of the horizontal drills must have a travel of 7½ inches. Two plates are placed in each jig. Some of the holes are so near together that two groups of drills in the turret are required before completing a piece. It takes the machine six minutes to drill six plates having 15 holes each, which is at the rate of one plate of 15 holes per minute, and yet the operator has